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A. D. MELVIN, CHIEF OF BUREAU.

THE CARE OF THE FARM EGG.

BY

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Animal Industry,
Washington, D. C., September 7, 1912.

Sir: I have the honor to transmit for publication as a bulletin of this bureau the accompanying manuscript entitled "The Care of the Farm Egg," by Messrs. Harry M. Lamon and Charles L. Opperman of the Animal Husbandry Division of this bureau. The work described is a continuation of the investigations into the egg trade which has been under way for several years.

In 1908 a careful survey of the conditions surrounding the trade was made, and the results were published as Circular 140, "The Egg Trade of the United States," wherein it was shown that there was a very heavy loss in the egg output, nearly all of which was attributed to improper methods of handling on the farm and at the country store. This loss was estimated to be fully 17 per cent of the total value, or $45,000,000 per annum.

In 1911 Bulletin 141, "The Improvement of the Farm Egg," was issued, one of the main objects of which was to emphasize the importance of the "loss-off" or quality system of trading in eggs. The present paper is supplemental to Bulletin 141 and makes a special feature of the value of producing infertile rather than fertile eggs.

Respectfully,

A. D. Melvin,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

INTRODUCTORY NOTE.

The egg investigations of 1910, which brought about the inauguration of the "loss-off" or quality system of buying eggs in Kansas, resulted in marked improvement in the quality of the eggs marketed from that State. The work of 1911 was devoted to keeping up the interest in the movement and to the study of the effect of farm conditions on the keeping quality of eggs, the results of which are presented herewith. The 1910 work emphasizes the effectiveness of organization as a means to improve the egg output of a community; the work of 1911 shows how the farmer may assure himself of maximum returns for his eggs by taking proper care of them and by proper management of his flock.

While the 1911 work was not, as some claim, a "discovery" of the superior keeping quality of the infertile egg, the authors deserve the credit for focusing public attention on the fact. Of the loss of $45,000,000 or more in the annual value of our egg crop, due to poor quality, at least one-third, or $15,000,000, is due to "blood rings." A blood ring is caused by the development of the embryo of a fertile egg subjected to heat and its subsequent death. No embryo can develop in an infertile egg, no matter how long it may be subjected to heat, because it is not fertile. Therefore a blood ring is impossible in the infertile egg; and by the removal of male birds from the flock as soon as the hatching season is over, and the segregation of young cockerels, no loss from blood rings will be experienced.

Unless cooled at once and kept cool, a fertile egg will spoil in hot weather almost as quickly as raw milk, and the purchaser of fertile eggs, even on the "loss-off" basis, whether he be the country-store merchant, the packer, or the consumer, has no assurance whatever against more or less loss. An infertile egg will keep; a fertile one will not. It therefore does not require a great stretch of the imagination to realize what effect the country-wide production of infertile eggs would have on our food supply.

Some of the loss due to "rots" and "spots," as shown in this bulletin, is caused by contamination in the nest and is largely, if not entirely, preventable. Both fertile and infertile eggs may be damaged in this way, although infertile eggs are less susceptible than fertile ones.

The propaganda work in Kansas has now been turned over to the Kansas State Agricultural College and Experiment Station at Manhattan, and the Animal Husbandry Division is now concentrating its efforts on the spread of the good-egg movement to other States, organizations having been effected already in Michigan and Minnesota. I firmly believe that if the egg-producing States generally will take up the matter of buying on a quality basis and the farmers are shown how to care for their eggs properly, especially to sell only infertile eggs during the summer months, the housewife will soon be able to observe a decided improvement in the quality of the eggs which she buys without having paid more for them than formerly. The means to improve the quality of the farm egg are so simple and inexpensive that anyone who keeps a flock of chickens should be able to apply them. In this connection the reader's attention is particularly directed to the five rules at the close of the bulletin.

In the investigations discussed in this bulletin the authors received a great deal of assistance from citizens of Kansas and from State officials, which has been greatly appreciated. Mr. Alfred R. Lee, of this division, also assisted part of the time in the investigation.

George M. Rommel,
Chief of the Animal Husbandry Division.

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THE CARE OF THE FARM EGG.

INTRODUCTION.

Since the poultry and egg industry of this country has assumed the enormous proportions indicated by the two last national censuses, 1900 and 1910, there has been a demand for and a growing interest in improved conditions and a need for a broader knowledge of the underlying principles of the industry. The State agricultural colleges and experiment stations have established departments of poultry husbandry for both teaching and research work. The experimental departments have given their attention to the various questions involved in the housing, feeding, breeding, and general management of poultry, while the instruction departments have built up practical courses in this branch of animal husbandry and have also assisted in disseminating the knowledge gained from the results of experimental work. Thus on every hand we can see an interest being manifested in improving the conditions in all branches of poultry work.

One of the most important of these is the production and marketing of eggs. Every year there is a loss of millions of dollars in bad eggs, the direct result of haphazard methods of production, marketing, and shipping which are now in vogue in many States. The greatest part of this loss is due mainly to ignorance or indifference on the part of the farmer and producer, and only a small part is caused by carelessness on the part of the buyer and shipper. In many instances the buyer is indirectly responsible, for when he buys eggs by the case-count system, as many of them do, he is encouraging the producer to be careless in gathering and marketing the eggs, since he pays him for anything that has an intact shell. The conscientious producer, however, will not try to shield himself under this pernicious system, so it is very much to his advantage to aid in the improvement of the commercial egg. He may not receive any extra compensation at the very start, but just as surely as he makes an organized effort to furnish the trade with strictly fresh eggs so surely will the competition in trade make it possible for him to dispose of his superior product at an increased profit.

It was with the view of determining the causes of the enormous loss in eggs, and if possible working out methods for its elimination, that the Department of Agriculture, through the Bureau of Animal

Industry, undertook a thorough investigation of the problem. Two publications,[1] one giving a bird's-eye view of the situation in several States and the other dealing specifically with the conditions in the State of Kansas, have already been issued. It was the knowledge gained through this general survey of conditions that suggested the undertaking of the experimental egg work set forth in the present paper.

THE GRADING OF EGGS.

Where eggs are handled in large quantities there are certain grades by which they are sorted and either retained for market purposes or rejected as useless. A brief description of these grades and the characteristics by which they are detected is given below.

Fresh egg.—An egg to be accepted as a first, or fresh egg, must be newly laid, clean, of normal size, showing a very small air cell, and must have a strong, smooth shell, of even color and free from cracks. With the exception of the air cell, which is only visible through the aid of the candle, these are the points by which eggs are graded in the early spring, at which time they are quite uniform in quality, thereby making candling unnecessary.

Checks.—This term applies to eggs which are cracked but not leaking.

Leakers.—As indicated by the name, this term applies to eggs which have lost a part of their contents.

Seconds.—The term "seconds" applies to eggs which have deteriorated to a sufficient extent as to be rejected as firsts. They are, however, of a high enough quality to be used for human consumption. The several classes of eggs which go to make up this grade may be defined as follows:

(*a*) Heated egg: One in which the embryo has proceeded to a point corresponding to about 18 to 24 hours of normal incubation. (See Pl. III, fig. 3.) In the infertile egg this condition can be recognized by the increased color of the yolk; when held before the candle it will appear heavy and slightly darker than in the fertile egg.

(*b*) Shrunken egg: This class of seconds can be easily distinguished by the size of the air cell. It may occupy from one-fifth to one-third of the space inside the shell. The holding of eggs for a sufficient length of time to allow a portion of the contents to evaporate is the main cause of this condition.

(*c*) Small egg: Any egg that will detract from the appearance of normal eggs on account of its small size will come under this class, although it may be a new-laid egg.

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[1] Hastings, Milo M. The egg trade of the United States. Bureau of Animal Industry Circular 140. Washington, 1909.

Lamon, Harry M., and Opperman, Charles L. The improvement of the farm egg. Bureau of Animal Industry Bulletin 141. Washington, 1911.

(*d*) Dirty egg: Fresh eggs which have been soiled with earth, droppings, or egg contents, or badly stained by coming in contact with wet straw, hay, etc., are classed as seconds.

(*e*) Watery egg: Those in which the inner membrane of the air cell is ruptured, allowing the air to escape into the contents of the egg, and thereby giving a watery or frothy appearance.

(*f*) Presence of foreign matter in eggs: In Plate III, figure 2, is given an excellent illustration of this class of eggs. The small dark streak across the yolk is a clot of blood. This condition is found in many fresh-laid eggs. Often eggs are laid which show small clots about the size of a pea. These are sometimes termed "liver" or "meat" spots.

(*g*) Badly misshapen eggs: Eggs which are extremely long or very flat, or in which part of the shell's surface is raised in the form of a ring; in other instances a number of hard wart-like growths appear on the outside of the shell.

Spots.—Eggs in which bacteria or mold growth has developed locally and caused the formation of a lumpy adhesion on the inside of the shell. There are three well-recognized classes of mold spots, namely, white, brown, and black. In cases where an infertile egg has been subjected to natural heat for a sufficient period of time, the yolk will often settle and become fixed to the membrane. This condition might be termed a "plain spot." In Plate VI, figures 3 and 4, are shown typical specimens of black mold and plain spot eggs.

Blood rings.—Eggs in which the embryo has developed to a sufficient extent so that it is quickly recognized when held before the candle. It has been found that it requires between 24 and 36 hours of incubation under a sitting hen to produce this condition. Good illustrations of these conditions are shown in Plate IV, figures 1 and 3, and in Plate V, figure 1.

Rots.—Eggs which are absolutely unfit for food. The different classes of rots may be defined as follows:

(*a*) Black rot: This is the easiest class of rots to recognize and consequently the best known. When the egg is held before the candle, the contents have a blackish appearance, and in most cases the air cell is very prominent. The formation of hydrogen-sulphid gas in the egg causes the contents to blacken and gives rise to the characteristic rotten-egg smell, and sometimes causes the egg to explode.

(*b*) White rot: These eggs have a characteristic sour smell. The contents become watery, the yolk and white mixed, and the whole egg offensive to both the sight and the smell. It is also known as the "mixed rot."

(*c*) Spot rot: In this case the foreign growth has not contaminated the entire egg, but has remained near the point of entrance. Such eggs are readily picked out with the candle, and when broken show lumpy particles adhering to the inside of the shell. These lumps are of various colors and appearances. It is probable that spot rots are caused as much by mold as by bacteria, but for practical purposes the distinction is unnecessary.

To all intents and purposes the spot rot as explained above is practically the same as the brown and black spots described under the general head of "Spots." The spot rot is also placed under the general head of rots simply because some candlers will call it a spot, while others designate it as spot rot. Pink and blood rots are names which are also applied to certain classes of rotten eggs, the pink rot deriving its name from the peculiar pinkish color of the contents when held before the candle. The same thing is true of the blood rot, which is bloody or red in appearance.

METHODS USED IN CONDUCTING THE EXPERIMENTS.

The plan of the work was to determine, in so far as could be shown by the candle, what deterioration took place in eggs when retained under actual conditions on the farms, in the country store, and during transportation. In choosing the field for the work careful consideration was given to the following points: A State where the production and marketing of eggs was an important factor, a location in that State where the cooperation of several farmers could be secured, and a town that was far enough from a central collecting point (or packing house) so that the effect of typical transportation conditions could be observed.

The eggs used in the various experiments were collected at a stated time each day from several farms and started in the experiment within an hour or two thereafter. Every egg was supposed to be absolutely fresh when entered in the experiments, and in all about 10,000 eggs were used during the season's work.

The six following classes of eggs were used: Clean fertile, dirty fertile, washed fertile, clean infertile, dirty infertile, and washed infertile.

Clean fertile eggs were normal fresh eggs produced by the farm flocks, on free range, with several mature male birds present during the entire season. Dirty fertile eggs were fresh eggs from the same flocks, but which before entering the experiments were artificially dirtied with barnyard mud to conform as nearly as possible with the natural dirty egg. Washed fertile eggs were fresh eggs from the above flocks which were thoroughly washed previous to being put in the experiments. In washing the eggs they were allowed to remain in a basin of water for a few moments and then well rubbed with an ordinary wash cloth and immediately dried with a towel. It is the general opinion that washed eggs do not keep as well as unwashed, and it was to determine this point that these eggs were used.

The three classes of infertile eggs used were identical with the fertile eggs, with the exception of being produced by flocks where the male birds were removed three weeks previous to using the eggs. It will be noted from the tables on the succeeding pages that experimental work with infertile eggs did not begin until after the 1st of June. This is due to the fact that under most farm conditions it would be impracticable to attempt to produce infertile eggs during the earlier spring months, as this is the season when the hatching and rearing of the coming year's flock must be attended to.

Every egg used was dated, which made it possible to secure a complete history of the egg from the time it was produced until it reached its final destination. This method of dating made each day's eggs in a given experiment a time experiment also. For example: A seven-day experiment having a given number of fresh eggs added each day, and these being dated, we obtained the influence of a certain environment for one, two, three, four, five, six, and seven days.

In Plate I, figures 1 and 2, is given a photographic reproduction of the thermographs used in connection with the work. The machine shown in figure 1 was located at the farm where the bulk of the work was carried on and used for recording the different temperatures and humidity. In figure 3 is a view of the apparatus in actual operation, the thermograph being inclosed in the box. The oilcloth covering was used to prevent the rain from entering the box and also to divert the direct rays of the sun. It was so arranged, however, that free circulation of air was not interfered with. A machine similar to that shown in figure 1 was used in the rooms of the dwelling house where certain experiments were conducted. The machine shown in figure 2 is constructed to record temperature only. It accompanied each shipment of eggs from the time it arrived at the country store, and while on the train, thereby furnishing a complete chain of temperature records for the experiments from the time the eggs were produced until they reached the packing house.

When the experiments were completed at the farm, which was in most cases seven days, the eggs were packed in ordinary 30-dozen cases, care being exercised to see that each experiment was kept separate. The transportation to town was by means of a team and buggy. After arriving in town, the eggs were candled immediately and an individual record made of the condition of each egg. This first candling represents the deterioration which occurred on the farm. The eggs were then repacked and held under typical country-store conditions for from 24 to 48 hours. The next operation was recandling, a similar record being made as above, showing the deterioration which took place while being held in the country store. They were then repacked and placed in an open stock car (the style of car used in that locality for shipping eggs and poultry) where they remained for about 12 hours before starting on their journey to the packing house, by local freight, a distance of 78 miles, requiring about 10 hours for the journey. The reason for placing the eggs in the car 12 hours previous to starting was due to the fact that the car was shipped early in the morning and it was often impossible for the merchants and local shippers to deliver the eggs at such an early hour.

After reaching the packing house the eggs were removed from the car in accordance with the usual custom and again candled. This third and last candling gave the deterioration which occurred during railroad transportation. The experiment, in so far as this paper is concerned, was then complete. The above methods of procedure were practically identical for all the experiments made during the entire season, and unless some special deviation occurred, no further mention will be made of them.

A sample candling report is here presented:

First town candling report. Date, June 8, 1911.

Date laid	June 1.	June 2.	June 3.	June 4.	June 5.	June 6.	June 7.	Total.
Firsts	3	2	3	3	4	5	5	25
Seconds	1	2	2	1	1			7
Cracked		1		1				2
Leakers								
Spots	1							1
Blood rings								
Rots								
Total	5	5	5	5	5	5	5	35

Second town candling report. Date, June 10, 1911.

Firsts	1	1	2	2	3	4	4	17
Seconds	3	3	3	2	2	1	1	15
Cracked		1		1				2
Leakers								
Spots	1							1
Blood rings								
Rots								
Total	5	5	5	5	5	5	5	35

Final candling report at packing house. Date, June 12, 1911.

Firsts			1	1	2	3	4	11
Seconds	4	4	4	3	3	2	1	21
Cracked		1		1				2
Leakers								
Spots	1							1
Blood rings								
Rots								
Total	5	5	5	5	5	5	5	35

In assembling the data connected with the work, the forms shown below were used. As will be seen upon inspection the card was used for recording the details concerning the experiment and the candling report for a record of the eggs. After being filled out, the card and report were fastened together and filed away for future reference.

[Front of card.]

[United States Department of Agriculture, Bureau of Animal Industry.]

POULTRY AND EGG MARKETING INVESTIGATIONS—HANDLING EGGS.

Observer.............................. Date......................... Experiment No.................
Statement of experiment..
....
Material used..
....
Eggs produced by.. Farmers' Card No.................
Date laid.................................. Where held...
Container and its condition.................................... How long held........................
Date and hour left farm for market...
Haul to market or store by farmer: Time............................... Miles..........................
Container...
Wagon........................ Condition of road.................
Haul to market or store by egg collector or huckster: Card No............ Time.......... Miles.........
Container...
Wagon.............. Condition of road.............
Store or buyer to whom sold... Card No...............
Date received at store.. How long held.......................
Where held............................... Container and its condition..................................
How packed for shipment..........................Kind and condition of cases and fillers..............
Date and hour left store for station............................ Length of haul..........................
Where held at station.................... How long held................ Covered or uncovered..........
Size of shipment................................... Time put on car.....................................
Kind of car............................ Eggs alone or eggs and poultry in car............................
Length and time of railroad haul................................. Reloaded...............................

[Back of card.]

Date and time of arrival at packing house...
How handled at packing house: How long before put in cooler.......... Temperature of cooler..........
Candling before or after cooling.................. Grading................... Packing................
Time held.. How shipped.....................................
Date and hour put in car for shipment.............. Kind of car............ Time of shipment......
To whom shipped............................... Date of shipment.................................
REMARKS...
....
....

DESCRIPTION OF THE EXPERIMENTS.

The question of selecting the proper conditions for the carrying out of the various experiments was one of vital importance, and it was only after careful consideration of the actual known conditions on the farms that the experiments described below were outlined. Experiments A and B were conducted with fertile and infertile dirty, washed, and clean eggs; Experiments C, E, F, and G with fertile and infertile clean and dirty eggs, while in Experiments D and H supposedly fertile eggs were used.

A. KEEPING EGGS IN DWELLING HOUSE.

The procedure followed in conducting an experiment with clean fertile eggs was as follows: Five eggs laid on a certain day were put in a clean receptacle (small grape basket) and placed in the parlor of the house (no artificial heat). Five fresh eggs were added each succeeding day until the experiment was completed at the farm, which was seven days in all cases except "stolen nest" and "under sitting hens." After once being put into the receptacle, the eggs were never removed from the room until they were packed and transferred to town. A constant record of temperature and humidity for the experiments was obtained by the use of a thermograph.

B. KEEPING EGGS IN CYCLONE CAVE.

The procedure for this experiment was identical with that given above, with the exception that instead of using a thermograph, an ordinary thermometer was employed, the temperature record being secured by reading three times daily. The use of the thermograph in this instance was unnecessary, as previous experience had shown that the temperature of the cave did not vary more than three or four degrees in a week, such a condition making it possible to procure a very accurate temperature record by the use of the thermometer.

In the section of the country where these experiments were conducted, many farmers did not have good, clean, dry cellars under their houses, but nearly all had what is known as "cyclone caves," in which are often kept the eggs produced on the farm. The conditions in many of these caves are as good as in the ordinary dry, unheated cellar. Plate II, figure 3, is a photograph of a cyclone cave, showing the entrance with doors open. These caves are often ventilated by a small window at the end opposite the door, and by a pipe leading through the top of the roof.

INEFFICIENT STORING FACILITIES ON THE FARM.

It has been pointed out in a previous publication (Bureau of Animal Industry Bulletin 141) that inefficient storage facilities on the farm are a serious difficulty with which the farmer's wife often has to contend, as a great many of the country homes in Kansas do not have dry, cool cellars, and when the thermometer begins to register from 100° to 106° F. there is no good place to keep perishable produce. To overcome this difficulty use is often made of the "cyclone cellar," or cave. In some instances these caves are of concrete construction throughout, and on such farms very little difficulty is experienced in keeping eggs in good condition. Some of these caves, however, are nothing more than oblong holes in the ground over which a rough gable roof is built. The soil which has been excavated to make the cave is thrown over this roof, and thoroughly packed so as to make it cool and practically waterproof. Caves of such construction are very hard to keep clean on account of the dampness and mold, which are always present when dirt walls and floor are used, and consequently they are very undesirable as a storage room for eggs. Dampness is conductive to the rapid development of mold and bacteria,

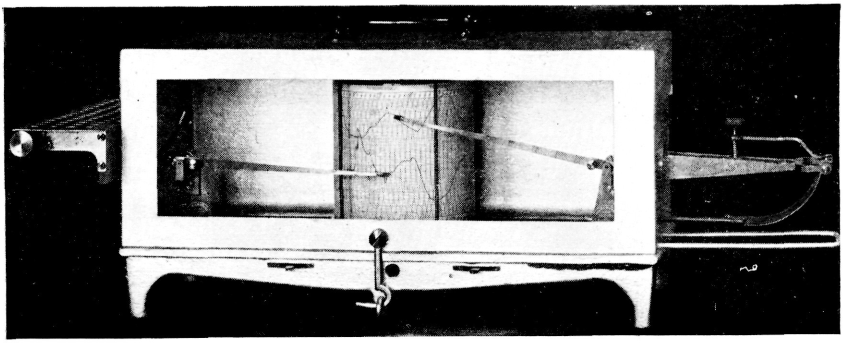

FIG. 1.—THERMOGRAPH RECORDING TEMPERATURE AND HUMIDITY.

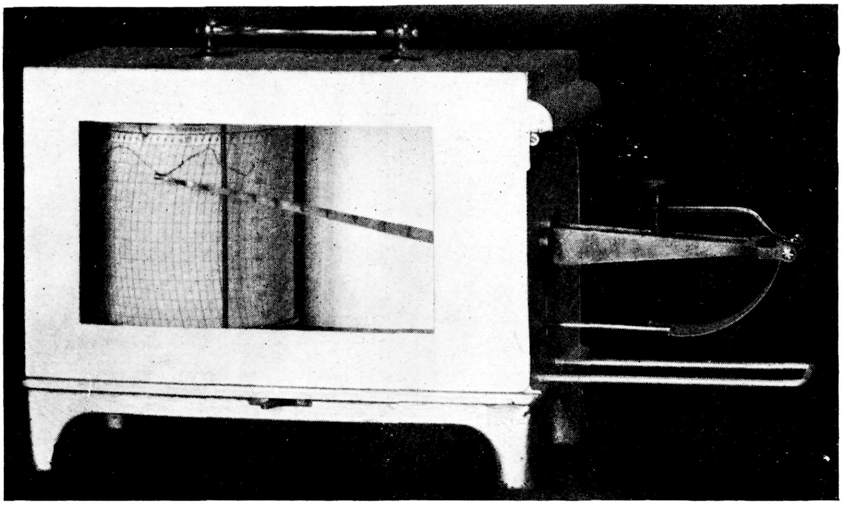

FIG. 2.—THERMOGRAPH RECORDING TEMPERATURE ONLY.

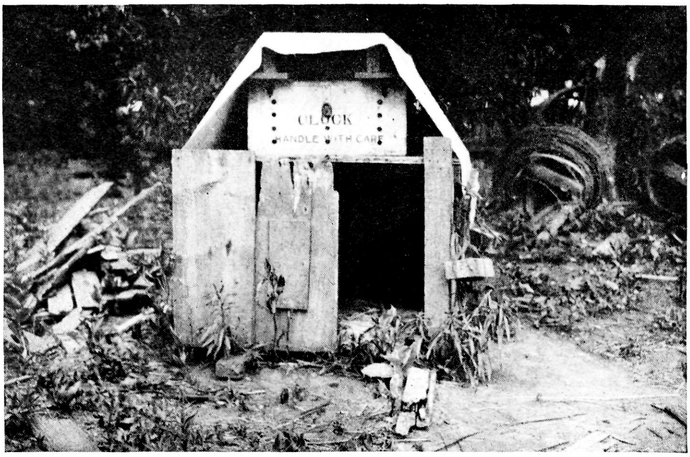

FIG. 3.—THERMOGRAPH IN OPERATION.

Plate II.

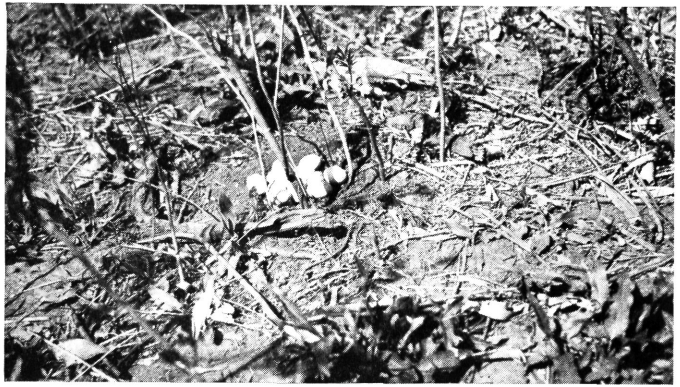

Fig. 1.—A Typical Weed Nest

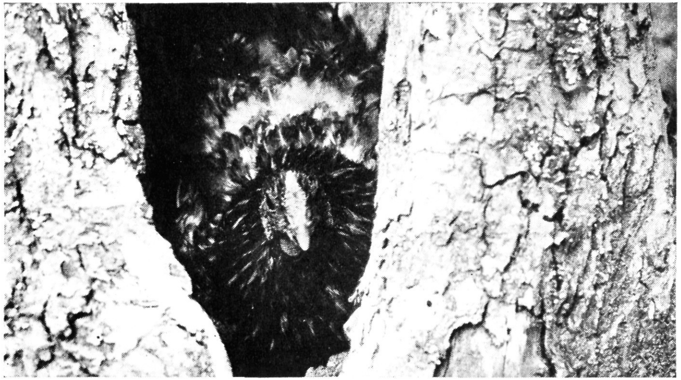

Fig. 2.—Stolen Nest in Hollow Apple Tree.

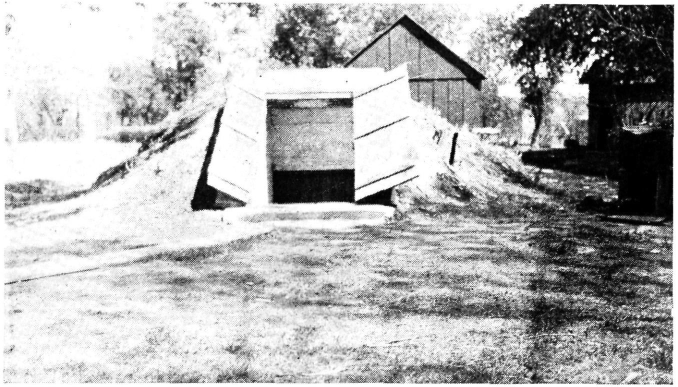

Fig. 3.—A Cyclone Cave.

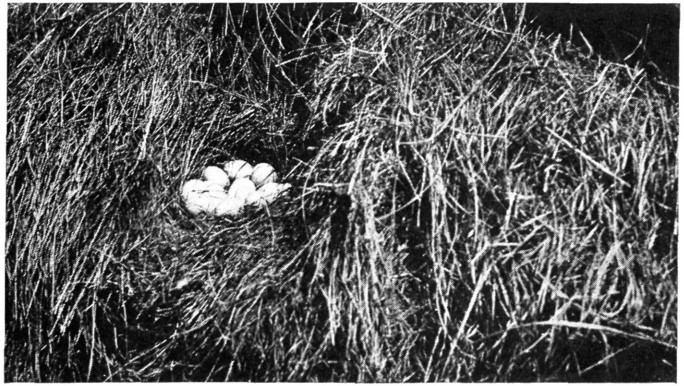

Fig. 4.—A Nest in a Straw Stack.

and consequently eggs kept in these caves are much more likely to show deterioration than if they were held in a dry room at the same temperature.

C. EGGS PLACED IN NESTS PROVIDED FOR LAYING HENS.

There can be no doubt of the fact that the annual loss in the United States on account of eggs becoming absolutely unfit for human food ("rots" and "spots") amounts to many millions of dollars. This much being conceded, the next problem is to ascertain when, where, and how this enormous deterioration is accomplished.

In this experiment, and in the others to follow, the object sought is definite knowledge as to the manner in which these inferior grades of eggs are produced. The fact that it is practically impossible, within a period of a few days and in normal weather, to produce spots and rots under the conditions of the two preceding experiments, made it necessary to typify in an experimental way the more abnormal conditions under which eggs might be subjected on the farm. Thus, in this experiment one of the bad effects due to infrequent gathering is seen.

With sitters in the flock.—On practically all farms during the spring and summer there are a certain number of broody hens which, if not used for hatching purposes, will spend more or less of their time sitting on the eggs in the nests utilized by the layers. This is true also, but in a less degree, even when an effort is made to break up the habit by taking the hens from the nests, during the day or at night, and placing them in yards or coops where there are no nests.

In this experiment the sitters were handled according to the usual custom on the farm—that is, they were removed from the nests every day or so and confined in a large coop for several days and then set at liberty. A daily record was kept of the number present on the nests so as to observe the rate of deterioration when few were present as compared with that when the sitters were numerous.

The method of conducting this experiment was as follows: Five eggs laid on a certain day were placed in several nests which were provided for the laying hens. Five fresh eggs were added each succeeding day until the experiment was completed at the farm. The time for this experiment was seven days. After the eggs were placed in the various nests they were not removed until packed and transferred to town.

No sitters on the nests.—After making provision for obtaining information as to the per cent of deterioration in eggs placed in nests for layers, with sitters present, it seemed desirable to investigate the problem from another standpoint, namely, that of a duplicate experiment having no sitters present. In this respect the cooperation of a farmer having a flock of White Leghorns was secured. This breed being nonsitters made it possible to carry out the desired project.

Care was exercised to see that any fowl showing a disposition to become broody was immediately confined. The method of conducting this experiment was exactly the same as that with the sitters on the nests.

D. PLACING EGGS UNDER SITTING HEN.

This experiment was instituted to determine accurately from a practical standpoint the period of time required to produce a blood ring that could be detected by the aid of the candle. Any changes occurring before this stage was reached were also observed and recorded. The experiment was divided into four parts, showing the influence of natural incubation for 24 hours, 36 hours, 48 hours, and 72 hours.

The procedure for the tests was as follows: From 10 to a dozen fresh fertile eggs were placed under a sitting hen and allowed to remain there for the specific time required by the test. They were then removed to the room in the dwelling house where Experiment A was carried on, and kept there until the experiment was completed at the farm. As soon as one lot of eggs was removed from under the hen a fresh lot was substituted, and the experiment carried on continually in this manner. Separate tests with infertile eggs were also carried on.

E. PLACING EGGS UNDER CORNCRIB.

In this experiment five clean, fertile, new-laid eggs were placed on the earth underneath the corncrib, and protected by means of an open-mesh wire hood. Five fresh eggs were added for each successive day until the experiment was completed at the farm. The eggs were never removed from under the corncrib until the experiment was ended.

F. EGGS PLACED IN NESTS IN WEEDS OR UNDERBRUSH.

In selecting the location for these nests care was exercised to have the conditions as natural as possible, and in most cases the locations decided upon were those that had already been chosen by the hens themselves. In conducting the experiment the following methods were used: Five clean fertile eggs laid that day were placed on the earth in the weeds or underbrush, and protected by means of an open-mesh wire hood. Five fresh eggs were added for each successive day until the experiment was completed at the farm, the time in this case being seven days. The eggs after being placed in the nests were never removed until packed and transferred to town.

G. EGGS PLACED IN NEST ON STRAW STACK.

The procedure in this case was similar to that given in the preceding experiment, with the exception that the eggs were put in nests on the straw stack instead of on the earth.

H. EGGS PLACED IN STOLEN NEST.

It is a common occurrence for the farm hen to locate her nest in some out-of-the-way place which is not likely to be discovered. These are designated "stolen nests." After choosing a location, she will lay from 10 to 15 eggs, and then start to sit. It often so happens that after sitting on the eggs for several days she will become indisposed and abandon the nest. In due course the eggs will be discovered by some of the members of the household, and if they are not educated as to what constitutes a good egg, they will put them in with the rest of the eggs that are sent to market. This is one of the channels through which thousands of dozens of bad eggs are placed on the market.

To secure knowledge concerning the quality of these eggs, the following method was adopted: After locating a stolen nest, the eggs of unknown history would be removed and a marked nest egg left. From that time on the nest was visited each day, and the eggs dated as they were laid. The hen was allowed to lay until she started to set, at which time the eggs were removed and transferred to town, where they were candled. The object was not to note the effect of steady incubation, but rather the condition of the eggs just previous to the time the hen would desire to set. Such data as temperature, rainfall, and the number of clear days were carefully recorded for each experiment.

RESULTS OF THE EXPERIMENTS.

Before discussing the results of the various experiments, it will be well to outline briefly the system followed in condensing the tables. In the Appendix at the end of this bulletin are given the detailed data from which the condensed tables referring to the cyclone-cave experiment were compiled. It may here be noticed that experiments Nos. 43, 44, and 45 all began on May 13 and ended at the farm on May 20. Each of these experiments, however, had to do with a certain class of fertile eggs with which tests were being conducted in the cave. In the condensed reports (see Tables 1, etc.) we have the total results for a part of the season, June 17 to August 26, for the fertile and infertile eggs of each of these different experiments given in the same general form as that used for recording the data of a seven-day experiment in the Appendix. In drawing conclusions from the condensed reports, it is obvious that cognizance can not be taken of the specific deterioration occurring in an experiment during a seven-day period of extremely hot or moderately cool weather. This point, however, will be taken up in another part of the paper. The fact that the results of the condensed reports are a true representation of the loss which the producer who allowed the eggs to remain in any of the various conditions would have to bear, makes it possible to reach conclusions that have a practical application.

The price allowed in this work for first, or fresh, eggs is 15 cents per dozen, and for seconds and cracks, 9 cents. Leakers, spots, blood rings, and rots are figured as a total loss. The above prices will correspond favorably with those allowed by buyers who purchased on the loss-off system during the season that the experiments were conducted. The per cent of loss which is given in the last column of the table is figured from the actual loss in dollars and cents, since this is the only basis by which the loss borne by the producer can be aptly represented. Loss at the packing house represents total loss from farm to packing house.

The reader will recall that in the descriptions of the different experiments mention was made of carrying on tests with dirty fertile and infertile eggs in some of the experiments. This was done for several weeks at the beginning of the season, but the results obtained were not considered of enough importance to continue them as first planned, and it was decided to continue them in the "house" and "weed-nest" experiments only. This was done in order that whatever difference there might be in the keeping qualities of dirty and clean eggs might be observed, and the retention of them in one inside and one outside experiment was considered sufficient to furnish such data as were desired.

A. THE HOUSE EXPERIMENTS.

The results obtained from the house experiments, as set forth in Table 1, may be noted as follows:

1. That all classes of eggs kept in this environment showed a much higher per cent of loss than those which were kept in the cyclone cave. This increased loss is accounted for by the fact that the daily maximum temperature in the house was from 15° to 40° higher than that of the cave. In the former the maximum temperature on two occasions reached 114° F., while in the latter it never exceeded 70° F.

2. The class of eggs wherein the greatest per cent of loss occurred was that of dirty fertile, although the clean fertile were less than one-half of 1 per cent less. In no way, however, can this slightly increased deterioration be attributed to the fact that the eggs were dirty, for in practically every instance the development of floats, blood rings, and rots were the causes of loss. Again, the variations in the losses of clean fertile, washed fertile, and dirty fertile were so slight when compared to each other that it would be impossible to say that the decreased or increased deterioration was caused through the eggs being clean, washed, or dirty.

3. That clean infertile eggs, as was the case in the cave experiments, again proved superior to all other classes, the loss at the packing house

being from 17 to 25 per cent less than in the classes of fertiles, which decrease is due mainly to the absence of spots, blood rings, and rots.

In view of the fact that infertile eggs should be sterile, it may seem peculiar to the reader that the above grades manifested their presence in this class of eggs. This may be explained, however, by the fact that after the middle of August the activity of the young cockerels is such that it is rather difficult to find a farmer who has a flock of chickens that are producing 100 per cent of infertile eggs. It is a condition that exists under practical conditions and cognizance of it must therefore be taken in a problem of this nature. In other words, it would detract from the value of the work to use 100 per cent infertile eggs at the season of the year when the farmer has to contend with a certain per cent of fertile ones. The farmer must retain a certain number of cockerels for breeding purposes, and if he is to produce strong vigorous males it is obvious that they can not be confined in small coops or yards.

4. Of the three classes of infertile eggs, the variations in loss are of such a minor nature that they can not be regarded as significant.

5. A comparison of the percentage of seconds in the three classes of fertile eggs with those in the same classes of infertile will show that during the seven days the eggs were held at the farm the fertile eggs produced the greatest proportion of seconds. This is also true of the second candling, but in the third and final candling the percentage of seconds was greater in the infertile eggs. This apparent decrease in the fertile seconds is due to the fact that many of the eggs which were seconds just before leaving town deteriorated to such an extent during transportation that they were graded as blood rings, etc., when candled at the packing house. This change, of course, did not take place in the infertile classes, which clearly explains the variation. As has been mentioned before, the infertile seconds were far superior to the fertile.

The results of this experiment may be briefly summarized in the following statements:

(*a*) An unheated room in a dwelling house is not as good a place to keep eggs as the cyclone cave, or dry, unheated cellar.

(*b*) The condition of clean infertile eggs, when candled at the packing house, was better than that of any other class.

(*c*) The keeping qualities of the three classes of fertile eggs are practically the same, which is also true for infertile during the time of the experiment.

(*d*) If the producer is to realize the maximum returns, he can not afford to keep fertile or infertile eggs in the house during the warm season.

TABLE 1.—*Condensed report of seven-day experiments with eggs kept in parlor of dwelling house.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*		*Dollars.*	*Dollars.*	*Per ct.*
June 17 to Aug. 26.	350, clean fertile	On arrival in town	146	42.1	169	48.7	3	0.9	0	0	0	0	29	8.4	0	0	347	4.34	1.22	28.2
		Before leaving town	106	30.5	180	51.9	7	2.0	0	0	0	0	53	15.3	1	.3	347	4.34	1.61	37.1
		Arrival at packing house	92	26.5	154	44.4	7	2.0	0	0	1	.3	53	15.3	40	11.5	347	4.34	1.98	45.6
Do	210, washed fertile.	On arrival in town	103	49.5	85	40.9	2	1.0	0	0	0	0	17	8.2	1	.5	208	2.60	.67	25.8
		Before leaving town	78	37.9	100	48.6	1	.5	0	0	0	0	25	12.1	2	1.0	206	2.58	.85	33.0
		Arrival at packing house	66	32.2	92	44.9	6	2.9	0	0	0	0	23	11.2	18	8.8	205	2.57	1.00	38.9
Do	210, dirty fertile	On arrival in town	81	38.4	111	52.6	3	1.4	0	0	0	0	16	7.6	0	0	211	2.64	.77	29.2
		Before leaving town	56	26.5	120	56.9	3	1.4	0	0	0	0	32	15.2	0	0	211	2.64	1.02	38.7
		Arrival at packing house	51	24.3	97	46.2	6	2.9	0	0	2	1.0	33	15.7	21	10.0	210	2.63	1.21	46.0
Do	350, clean infertile.	On arrival in town	246	70.5	94	26.9	8	2.3	1	.3	0	0	0	0	0	0	349	4.36	.52	11.9
		Before leaving town	199	57.5	138	39.9	9	2.6	0	0	0	0	0	0	0	0	346	4.32	.74	17.1
		Arrival at packing house	164	47.4	171	49.4	9	2.6	0	0	1	.3	1	.3	0	0	346	4.32	.92	21.3
Do	210, dirty infertile.	On arrival in town	143	69.1	63	30.5	1	.5	0	0	0	0	0	0	0	0	207	2.59	.32	12.4
		Before leaving town	105	50.7	101	48.8	1	.5	0	0	0	0	0	0	0	0	207	2.59	.51	19.7
		Arrival at packing house	98	47.5	103	50.0	3	1.5	0	0	1	.5	1	.5	0	0	206	2.57	.55	21.4
Do	210, washed infertile.	On arrival in town	129	61.4	77	36.7	4	2.0	0	0	0	0	0	0	0	0	210	2.63	.41	15.6
		Before leaving town	114	54.3	90	42.9	4	2.0	0	0	0	0	1	.5	1	.5	210	2.63	.49	18.6
		Arrival at packing house	89	42.4	100	47.6	6	2.9	0	0	0	0	14	6.7	1	.5	210	2.63	.72	27.4

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. This variation is due to eggs being broken or lost.

B. THE CYCLONE-CAVE EXPERIMENTS.

A perusal of Table 2, which deals with eggs retained in a cyclone cave, will show the following important points: (1) That with all classes of eggs, both fertile and infertile, there was practically no loss from the time the eggs were produced until they left town for the packing house, and after reaching the packing house the greatest loss, which was in the clean fertile class, did not exceed 19.8 per cent of the total value of the eggs. (2) That the loss occurring in clean and washed fertile eggs is nearly the same. A result of this kind would indicate that fertile eggs which had become soiled in the nest could be washed and retained in the cave without any serious deterioration taking place if the operation was performed in the manner herein described. It must be borne in mind, however, that in this case, while washed eggs stored under good conditions apparently kept as well as unwashed, the fact that contact with water tends to remove or dissolve the mucilaginous coating of the eggshell, thereby lessening the resistance to the invasion of molds and bacteria and also allowing more rapid evaporation of the contents, makes such eggs inferior for storing purposes when compared with clean eggs. (3) That the infertile eggs proved their superior keeping qualities over all others. The important point to be brought out in connection with infertile eggs is that the absence of fertilization makes it impossible for such eggs to develop into blood rings or chick rots, while in the fertile eggs these grades of deteriorated eggs comprise the great bulk of the loss. While the number and percentage of infertile seconds is only 10 per cent less than that of fertile, it is important that we thoroughly understand the great difference which exists in the quality of these two classes of seconds. For example, it will be sufficient to say that from 90 to 95 per cent of the infertile seconds were so designated on account of a slight shrinkage in the contents of the eggs, thereby causing the air cell to appear larger than that found in the fresh egg, while with the fertile seconds there was a very noticeable deterioration or change brought about by the development of the living embryo. In other words, there occurs no change in the former which would tend to render the egg unfit for food, while in the latter the composition of the egg is undergoing a marked change through the development of life within the egg. These differences are well illustrated in Plates III, IV, and V. Furthermore, it may here be stated that the great differences in fertile and infertile seconds were much more noticeable when the eggs were kept under other conditions than in the cave experiments.

The conclusions, so far as may be drawn from the data at hand are, first, that all classes of eggs retained in the cyclone cave showed a very small percentage of loss from the time they were produced until they reached cold storage. Second, that clean infertile eggs proved superior to all other classes, and washed infertiles second best. Third, that clean and washed fertile eggs compared favorably with the same classes of infertile while retained in the cave, but showed a tendency to deteriorate more rapidly during transportation from farm to packing house.

C. EXPERIMENTS WITH EGGS PLACED IN NESTS FOR LAYERS.

From Table 3, which shows the results of these experiments, we may note the following points:

1. In both the experiments with clean fertile eggs the resulting loss was far in excess of any other condition. In the first case, where sitters were present, the high rate of deterioration is due to the more or less constant sitting of broody hens on the nests, while in the latter it was caused by a scarcity of nests. There were no sitters present in the latter, but the fact that 8 or 10 hens would lay in the same nest daily brought about practically the same condition, and, as will be observed from the table, the total loss was even greater in the latter instance.

2. A comparison of the total losses for fertile and infertile eggs will show that in the former class when sitters were not present the loss was 38.6 per cent greater than that in the infertile, and where sitters were present the loss was 32.8 per cent greater. The bulk of the loss in the two fertile-egg experiments was caused by the development of blood rings and rots, while in the infertile it was due to seconds.

3. The infertile eggs proved to be more resistant to deterioration than the fertile when placed in nests for layers with the sitters present. The total loss at the packing house for fertiles (sitters present) was 64.2 per cent and for infertiles under the same conditions only 31.4 per cent. It must also be remembered that the quality of the infertile eggs was superior to the fertiles, since the seconds, which comprise the bulk of the loss in this class, are so designated simply because they show a slight shrinkage of contents and in some instances a little heat. Figures 3 and 4 in Plate III illustrate the difference between the fertile and infertile seconds of this experiment.

The conclusions for this test may be summarized as follows: First, irregularity in gathering the eggs from the nests used by the layers is one of the ways in which a serious loss in the quality of the egg may occur on the farm. Second, infertile eggs are the most resistant to this condition. Third, the greatest loss in fertile eggs occurred in the test when sitters were not present. The reason for this has been explained, and it is quite probable that even in instances when one nest was provided for every four or five hens the loss resulting from irregularity in gathering the eggs would be about as serious as that where sitters are present.

TABLE 2.—*Condensed report of seven-day experiments with eggs kept in cyclone cave.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dolls.*	*Dolls.*	*Per ct.*
June 17 to Aug. 26.	455, clean fertile	On arrival in town	410	90.3	30	6.6	14	3.1	0	0	0	0	0	0	0	0	454	5.67	0.22	3.9
		Before leaving town	367	81.0	72	15.9	14	3.1	0	0	0	0	0	0	0	0	453	5.66	.43	7.6
		Arrival at packing house	255	56.8	167	37.2	22	4.9	0	0	2	.4	3	.7	0	0	449	5.61	1.11	19.8
Do	273, washed fertile.	On arrival in town	253	93.7	12	4.5	4	1.5	0	0	0	0	1	.4	0	0	270	3.38	.09	2.7
		Before leaving town	227	84.1	35	13.0	7	2.6	0	0	0	0	1	.4	0	0	270	3.38	.22	8.3
		Arrival at packing house	167	61.6	97	35.8	6	2.2	0	0	0	0	1	.4	0	0	[1] 271	3.39	.52	15.3
Do	455, clean infertile	On arrival in town	442	97.2	4	.9	8	1.8	0	0	0	0	0	0	1	.2	455	5.69	.07	1.2
		Before leaving town	432	95.2	14	3.1	8	1.8	0	0	0	0	0	0	0	0	454	5.67	.11	1.9
		Arrival at packing house	325	71.6	115	25.4	12	2.7	2	.4	0	0	0	0	0	0	454	5.67	.65	11.5
Do	273, washed infertile.	On arrival in town	259	95.3	10	3.7	3	1.1	0	0	0	0	0	0	0	0	272	3.40	.06	1.8
		Before leaving town	255	93.8	13	4.8	4	1.5	0	0	0	0	0	0	0	0	272	3.40	.08	2.4
		Arrival at packing house	195	72.5	72	26.8	2	.7	0	0	0	0	0	0	0	0	269	3.36	.37	11.0

[1] Extra egg recorded at packing house.

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. This variation is due to eggs being broken or lost.

TABLE 3.—*Condensed report of seven-day experiments with eggs placed in nests for layers.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dolls.*	*Dolls.*	*Per. ct.*
May 20 to Aug. 26.	497, clean fertile (sitters present).	On arrival in town	77	15.7	248	50.6	6	1.2	0	0	0	0	132	26.9	27	5.6	490	6.12	3.26	53.3
		Before leaving town	49	10.0	231	47.2	11	2.3	0	0	0	0	156	31.9	42	8.6	489	6.11	3.41	55.8
		Arrival at packing house	58	11.9	186	38.3	7	1.4	1	0.3	1	0.3	124	25.5	109	22.4	486	6.08	3.90	64.2
May 23 to Aug. 26.	479, clean fertile (no sitters).	On arrival in town	60	13.2	210	46.1	10	2.2	0	0	0	0	142	31.2	34	7.5	456	5.70	3.30	58.0
		Before leaving town	33	7.2	195	42.8	11	2.4	0	0	0	0	165	36.2	52	11.4	456	5.70	3.74	65.6
		Arrival at packing house	31	6.8	164	36.2	5	1.1	1	.2	3	.7	127	28.0	123	27.1	454	5.67	4.01	70.8
May 20 to Aug. 26.	479, clean infertile (sitters present).	On arrival in town	230	49.0	216	46.0	12	2.6	0	0	0	0	10	2.1	2	.4	470	5.87	1.29	22.0
		Before leaving town	167	36.2	265	57.4	14	3.0	1	.2	0	0	12	2.6	3	.7	462	5.78	1.60	27.7
		Arrival at packing house	129	28.2	295	64.6	15	3.3	0	0	0	0	13	2.9	5	1.1	457	5.71	1.78	31.4

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. This variation is due to eggs being broken or lost.

D. THE SITTING HEN EXPERIMENTS.

The chief value of this experiment lies in the fact that the results obtained enable us to state accurately the least time required to render a fertile egg unfit for food.

1. Fertile eggs after being incubated under a sitting hen for 24 hours developed into what is known to the trade as light floats. The only change manifested in infertile eggs under the same conditions was a slight shrinkage in the contents, thereby causing the air cell to appear larger than that found in the fresh laid egg.
2. In the 36-hour test it was very apparent that some time between 24 and 36 hours of incubation the blood commences to assume sufficient prominence so that it can be detected when held before the candle. After being allowed to die, the embryo takes on an appearance as shown in Plate IV, figure 1, where it will be seen that the blood settles toward the edge of the yolk, forming an irregular circle. In infertile eggs, with the exception that the air-cell is necessarily larger, the change is practically the same as that explained above in the 24-hour test.
3. That in the 48 and 72 hour tests (see Plate IV, fig. 3) the appearance of the fertile eggs, in relation to the formation of blood, is similar to that found after 36 hours except that the development is much more marked. In Plate V, figure 1, is shown a living embryo after 72 hours of incubation, and in Plate VI, figure 1, the same egg after life had become extinct. Infertile eggs which have been subjected to this amount of incubation are similar in appearance to that shown in Plate V, figure 2. They do, however, show an increased amount of shrinkage, or enlargement of the air cell, as incubation proceeds.

The conclusion to be drawn from this investigation is that after 36 hours of incubation there is a sufficient quantity of blood present in a fertile egg when held before the candle to be detected by the naked eye.

It may be noted that there is no table accompanying this experiment. The photographic representations given in Plates III, IV, V, and figures 1 and 2 of Plate VI present the case so forcibly that no tabular data are needed. These pictures show conclusively how rapidly fertile eggs deteriorate under a sitting hen, and they also show the great superiority of infertile eggs under these conditions.

E. THE CORNCRIB EXPERIMENT.

The conditions of the two experiments just discussed were, so to speak, normal, while those of this experiment and of the succeeding ones are abnormal. The object in the former case was to ascertain which of the two places was most conducive to good quality in eggs, while in the latter case definite knowledge as to where and how the great mass of bad eggs are produced was sought. If the producer is to be educated along these lines, it is desirable that we not only determine where eggs keep well, but also that we point out the possible conditions that may give rise to a great number of bad eggs. Such information may enable him, if he so desires, to eliminate certain undesirable conditions and thereby increase the production of good marketable eggs.

From the data in Table 4 we may note the following points: A comparison of the losses in clean fertile and infertile eggs kept under a corncrib will show that the latter class was more resistant to the environmental conditions of the experiment. This is particularly noticeable in the grades of spots, blood rings, and rots, where the infertile egg, on account of its keeping qualities, could not deteriorate because of the development of life within it. It will be remembered that spots, blood rings, and rots are a total loss, and in the clean fertile eggs 25.1 per cent of the total number were classed under these grades, while in the clean infertile only 2.4 per cent were discarded for like deterioration. As has been mentioned before, the activity of the young cockerels was the cause of a small per cent of fertility in the supposedly infertile eggs.

A comparison of the seconds in the two classes will show a similar condition to that just explained in the "House experiment."

To sum up briefly, we may say that when kept on the earth under the corncrib, clean infertile eggs retained the qualities described in eatable eggs better than those which were fertile.

TABLE 4.—*Condensed report of seven-day experiments with eggs kept under corncrib.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dolls.*	*Dolls.*	*P. ct.*
June 10 to Aug. 26.	385, clean fertile...	On arrival in town................	151	40.9	194	52.6	2	0.5	0	0	0	0	22	6.0	0	0	369	4.61	1.25	27.1
		Before leaving town..............	89	24.1	227	61.6	5	1.4	0	0	0	0	47	12.7	1	.3	369	4.61	1.76	38.2
		Arrival at packing house..........	100	27.3	171	46.6	4	1.1	0	0	3	.8	59	16.1	30	8.2	367	4.59	2.02	44.0
Do.....	385, clean infertile.	On arrival in town................	266	70.2	108	28.5	5	1.3	0	0	0	0	0	0	0	0	379	4.74	.56	11.8
		Before leaving town..............	206	54.6	163	43.2	7	1.9	0	0	0	0	1	.3	0	0	377	4.71	.86	21.0
		Arrival at packing house..........	172	45.6	186	49.4	10	2.7	0	0	1	.3	6	1.6	2	.5	377	4.71	1.09	23.2

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. This variation is due to eggs being broken or lost.

F. THE WEED-NEST EXPERIMENT.

From the data in Table 5 we note:

1. That of the three classes of eggs with which tests were carried on in the weed nests dirty fertile suffered the greatest loss. It is noticeable, however, that the difference in loss between clean and dirty fertile is very slight.

2. The development of blood rings and rots in both classes of fertile eggs was the main cause of the heavy loss. While it is true that the seconds are responsible for a part of this loss, the actual figures for the 385 clean fertile eggs would be 81 cents loss for seconds and cracked, and a combined loss of $1.23 for spots, blood rings, and rots. In the case of the 231 dirty fertile eggs, the figures would be 50 cents loss for seconds, and 74 cents for the blood rings and rots, which proves that the burden of the loss must be credited to the spoiled eggs.

3. A comparison of the losses at the packing house (see last column of the table) gives superiority to the clean infertiles by a margin of 21.8 per cent, again demonstrating that infertile eggs possess in a much higher degree those qualities which tend to make them resistant to undesirable keeping conditions.

The conclusions which may be reached from this experiment are: First, that fertile eggs which might be laid in nests in the weeds and not discovered for several days can easily develop into spots, blood rings, and rots during the warm weather. Second, that infertile eggs under the same conditions do not deteriorate to the extent of fertiles. Third, that of all clases, clean infertile were in the best condition when candled at the packing house.

TABLE 5.—*Condensed report of seven-day experiments with eggs kept in weed nest.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dolls.*	*Dolls.*	*P. ct.*
June 10 to Aug. 26.	385, clean fertile...	On arrival in town..................	129	35.3	216	59.0	7	1.9	0	0	0	0	14	3.8	0	0	366	4.58	1.35	29.5
		Before leaving town................	85	23.3	222	60.8	10	2.7	0	0	0	0	47	12.9	1	.3	365	4.57	1.76	38.5
		Arrival at packing house...........	104	28.5	155	42.5	8	2.2	0	0	2	.5	77	21.1	19	5.2	365	4.57	2.04	44.7
Do.....	231, dirty fertile...	On arrival in town..................	74	33.9	120	55.1	8	3.7	1	.5	0	0	14	6.4	1	.5	218	2.73	.84	30.8
		Before leaving town................	48	22.1	124	57.2	7	3.2	1	.5	0	0	36	16.6	1	.5	217	2.72	1.14	41.9
		Arrival at packing house...........	59	27.2	91	41.9	8	3.8	0	0	0	0	51	23.5	8	3.8	217	2.72	1.24	45.6
Do.....	385, clean infertile.	On arrival in town..................	240	64.4	116	31.1	17	4.6	0	0	0	0	0	0	0	0	373	4.66	.66	14.2
		Before leaving town................	200	53.9	154	41.5	17	4.6	0	0	0	0	0	0	0	0	371	4.64	.86	18.5
		Arrival at packing house...........	162	43.8	178	48.1	21	5.7	0	0	2	.5	7	1.9	0	0	370	4.62	1.10	23.8

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. This variation is due to eggs becoming broken or lost.

G. THE STRAW-STACK EXPERIMENT.

From the results of this experiment, as set forth in Table 6, we may note the following points:

1. The difference in loss between clean fertile and infertile is much less than that of any other experiment, which would indicate that the conditions of the straw-stack nest were of such a severe nature that the infertile eggs were unable to resist it as successfully as they did in the other cases. This point is well illustrated by the figures in the column headed "Rots," where it will be noted that fully 5 per cent of both classes of eggs were so designated when candled at the packing house. Further illustration is found in the fact that in both fertile and infertile eggs the number of spots was greater than that experienced under any other condition.

It may also be of interest to note that during the extremely hot week of July 1 to 8 eggs that had been in this experiment after being candled at the packing house were broken and the albumen found to be cooked so hard that it could be cut with a knife without running.

2. The clean fertile eggs contained 20 blood rings (see candling report at packing house) while in the infertiles none were present, thereby making the total loss greater than in the infertile eggs.

3. Even under these severe conditions 24.8 per cent of the infertile eggs graded as firsts at the packing house, again demonstrating that this class of eggs is more resistant to bad conditions than any other. In concluding, we may say that this experiment gave the greatest number of spots and rots in infertile eggs.

TABLE 6.—*Condensed report of seven-day experiments with eggs placed in straw-stack nest.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dolls.*	*Dolls.*	*P. ct.*
June 10 to Aug. 26.	385, clean fertile	On arrival in town	52	13.8	296	78.8	10	2.7	0	0	14	3.7	4	1.1	0	0	376	4.70	1.76	37.5
		Before leaving town	35	9.3	306	81.6	12	3.2	0	0	11	2.9	9	2.4	2	.5	375	4.69	1.86	39.8
		Arrival at packing house	50	13.5	253	68.2	17	4.6	0	0	12	3.2	20	5.4	19	5.1	371	4.64	1.99	42.9
Do.	385, clean infertile.	On arrival in town	108	29.1	226	60.9	10	2.7	0	0	23	6.2	0	0	4	1.1	371	4.64	1.52	32.8
		Before leaving town	86	23.6	230	63.1	12	3.3	0	0	32	8.8	0	0	4	1.1	364	4.55	1.66	36.5
		Arrival at packing house	90	24.8	230	63.4	16	4.4	0	0	8	2.2	0	0	19	5.2	363	4.54	1.57	34.6

NOTE.—A comparison of the figures under the column headed "Total eggs and condition" with those under the column "Total eggs candled" will often show a variation. This variation is due to eggs becoming broken or lost.

H. THE STOLEN-NEST EXPERIMENTS.

Before discussing the results of these tests, as set forth in Tables 7, 8, and 9, it will be well to state that whenever two or more hens would lay in a nest on the same day all but one of the eggs laid were removed. This was done to keep the factor constant and not varying from day to day.

That there is a great difference in the quality of fertile eggs taken from a stolen nest just previous to the time the hen starts to sit is well brought out in Tables 7 and 8. In Table 7 it will be noted that 9 out of the 10 eggs were graded as seconds and the remaining 1 as a first, while in Table 8 there are 9 blood rings and 2 seconds. The only logical reason that can be set forth as the probable cause of such a variation is that the hen responsible for the eggs in nest 2 was inclined to sit on the eggs for a longer period each day during the time she was accumulating the nest of eggs than was the hen of nest 1. The fact that both experiments were conducted on practically the same days of the month makes the weather conditions identical in each case and eliminates the possibility of variations in temperature being responsible for the increased deterioration of the eggs in the latter nest. In both cases it was accurately determined, by breaking the eggs directly after candling, that those candled as seconds were fertile, since they showed similar development to that shown in Plate III, figure 3. The development had, of course, proceeded further in some instances than in others, but in every case it was of sufficient prominence to positively identify the egg as fertile.

Turning to Table 9, which is a condensed report of the detailed records of the 12 stolen nests, we may note (1) that out of the total of 88 eggs only 7.9 per cent could be classed as firsts when removed from the nest; (2) that slightly over one-half of the number had developed into seconds, 38.6 per cent being a total loss, and (3) that there was a total money loss of 60 per cent of the original value of the eggs. Such results as these, when we consider that the eggs had not been set upon steadily, as is the case in many nests of eggs which are found on the farm, are sufficiently convincing to prove that the eggs procured from such sources can easily be responsible for a part of the great loss now borne by the producer.

TABLE 7.—*Record of stolen nest No. 1, located in weeds.*

Dates visited.	Number of hens laying in nest.	Hen sitting.	Weather conditions.				Date candled.	Grade of egg.
			Rain.	Sky.	Temperature.			
					Max.	Min.		
			Inches.		°*F.*	°*F.*		
May 12	1	No	0.00	Clear	87	44	May 24	Second.
May 13	1	No	T.[1]	Pt. cl[2]	87	57	do	Do.
May 14	1	No	.22	do	84	65	do	Do.
May 15	2	No	.00	do	81	52	do	Do.
May 16	1	No	.00	do	90	65	do	Do.
May 17	1	No	.00	Clear	91	64	do	Do.
May 18	2	No	.00	Pt. cl.	93	72	do	Do.
May 19	3	No	.00	do	89	70	do	Do.
May 20	1	No	.00	do	75	52	do	Do.
May 21	0	No	.58	do	66	50	do	
May 22	1	No	.00	do	61	41	do	First.
May 23	0	Yes	.00	Clear	85	62	do	

[1] Trace. [2] Part cloudy.

NOTE.—Second showed 24-hour development.

TABLE 8.—*Record of stolen nest No. 2, located in woodpile.*

Dates visited.	Number of hens laying in nest.	Hen sitting.	Weather conditions.				Date candled.	Grade of egg.
			Rain.	Sky.	Temperature.			
					Max.	Min.		
			Inches.		°*F.*	°*F.*		
May 12	1	No	0.00	Clear	87	44	May 26	Blood ring
May 13	1	No	T.[1]	Pt. cl.[2]	87	57	do	Do.
May 14	1	No	.22	do	84	65	do	Do.
May 15	0	No	.00	do	81	52	do	
May 16	1	No	.00	do	90	65	do	Do.
May 17	1	No	.00	Clear	91	64	do	Do.
May 18	1	No	.00	Pt. cl.[2]	93	72	do	Do.
May 19	1	No	.00	do	89	70	do	Do.
May 20	0	No	.00	do	75	52	do	
May 21	1	No	.58	do	66	50	do	Second.
May 22	1	No	.00	do	61	41	do	Blood ring.
May 23	1	No	.00	Clear	85	62	do	Do.
May 24	0	No	.00	do	96	55	do	
May 25	1	No	.00	do	95	67	do	Second.
May 26	0	Yes	.00	do	94	69	do	

[1] Trace. [2] Part cloudy.

NOTE.—Second showed 24-hour development.

TABLE 9.—*Condensed report of stolen nests.*

Total number of nests.	Total eggs.	Results of candling.								Original value of eggs at 15 cents per dozen.	Loss.	
		Firsts.		Seconds.		Blood rings.		Rots.				
		Number.	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Dollars.*	*Dollars.*	*Per ct.*
12	88	7	7.9	47	53.4	27	30.7	7	7.9	1.10	0.66	60

COMPARISON OF CLEAN FERTILE EGGS UNDER SEVEN DIFFERENT CONDITIONS.

We have already discussed the results of the seven different experiments incorporated in Table 10, and it will now be of interest to compare collectively the total number of clean fertile eggs in each of them. Before doing so, however, it is well to call attention to the fact that the date in the table on which the tests with clean fertile eggs began is with one exception given as April 24, while in the condensed tables referring to the separate experiments it is given in some instances as June 10 and in others as June 17. This apparent contradiction is owing to the fact that the tests with infertile eggs did not start until the latter dates, and if we are to compare the results of experiments with these two classes of eggs, it is obvious that the work in each case must start and end on identical dates.

From the data in Table 10 the following points will be noted:

1. A comparison of the number and per cent of blood rings and rots which were present in the eggs of the different experiments when candled at the packing house will show that those kept in the cave were the only ones that did not suffer a heavy loss through these two grades. In the cave eggs the loss from this source was only 0.5 per cent, while in the remaining experiments it varies from 8.8 per cent for straw stack to 55.1 per cent in nests for layers.

2. The conditions in the straw-stack experiment gave rise to the greatest number of spots. By referring to Table 11, it can be seen that this also held good in the case of infertile eggs.

3. By comparing the total per cent of loss of each experiment it will be seen at a glance that the irregular gathering of the eggs (nests for layers test) was the cause of the greatest loss both at the farm and packing house. On the other hand one can see immediately that, excepting the cave experiment, the various conditions under which the tests were made are responsible for a large part of the bad eggs which we find on the market to-day.

4. In all experiments except the cave the total depreciation in the quality of clean fertile eggs is of enough importance to justify the statement that high-quality eggs can not be produced under any of these conditions. The best place to keep eggs, other than the cave, was found in the parlor of the dwelling house, and even here we note a total loss of one-third of the value of the eggs when candled at the packing house. This result must obviously eliminate such a location as a suitable place to keep fertile eggs during the warm weather, which leaves the cave or dry, cool cellar as the only alternative.

TABLE 10.—*Comparison of clean fertile eggs under seven different conditions.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dollars.*	*Dollars.*	*Per ct.*
Apr. 24 to Aug. 26.	641 clean fertile eggs in cave.	On arrival in town	588	92.8	31	4.9	15	2.4	0	0	0	0	0	0	0	0	634	7.92	0.23	2.9
		Before leaving town	538	85.0	80	12.6	15	2.4	0	0	0	0	0	0	0	0	633	7.91	.47	5.5
		Arrival at packing house	420	66.8	177	28.2	27	4.3	0	0	2	.3	3	.5	0	0	629	7.86	1.08	13.9
Do	653 clean fertile eggs in parlor of dwelling house.	On arrival in town	407	62.9	203	31.4	7	1.1	0	0	0	0	30	4.6	0	0	647	8.09	1.43	17.8
		Before leaving town	328	51.0	247	38.3	11	1.7	0	0	0	0	57	8.9	1	.2	644	8.05	2.01	25.7
		Arrival at packing house	267	41.7	261	40.8	15	2.3	0	0	1	.2	56	8.8	40	6.3	640	8.00	2.59	32.0
Do	653 clean fertile eggs under corn-crib.	On arrival in town	351	55.2	251	39.4	7	1.1	0	0	0	0	27	4.3	0	0	636	7.95	1.63	20.4
		Before leaving town	233	36.9	335	53.0	9	1.4	0	0	0	0	54	8.5	1	.2	632	7.90	2.41	30.5
		Arrival at packing house	247	39.3	267	42.5	11	1.8	0	0	3	.5	71	11.3	30	4.8	629	7.86	2.69	34.3
Do	653 clean fertile eggs in weed nest.	On arrival in town	324	52.1	270	43.4	13	2.1	0	0	0	0	14	2.3	1	.2	622	7.77	1.60	20.6
		Before leaving town	247	40.2	299	48.6	20	3.3	0	0	0	0	47	7.6	2	.3	615	7.69	2.20	28.6
		Arrival at packing house	233	38.0	257	42.0	18	2.9	0	0	2	.3	83	13.6	20	3.3	613	7.66	2.68	35.0
Do	653 clean fertile eggs in straw stack.	On arrival in town	227	35.4	377	58.8	17	2.7	0	0	14	2.2	4	.6	2	.3	641	8.01	2.22	27.7
		Before leaving town	178	28.0	414	65.2	19	3.0	0	0	11	1.7	9	1.4	4	.6	635	7.94	2.46	31.0
		Arrival at packing house	173	27.5	362	57.6	26	4.1	0	0	12	1.9	32	5.1	23	3.7	628	7.85	2.78	35.4
Do	646 clean fertile eggs in nests for layers (sitters present).	On arrival in town	135	21.3	304	48.0	7	1.2	0	0	0	0	158	25.0	29	4.6	633	7.91	3.89	49.1
		Before leaving town	113	17.9	272	43.1	12	1.9	0	0	1	.2	182	28.9	50	7.9	630	7.88	4.33	55.0
		Arrival at packing house	103	16.4	239	38.0	9	1.4	1	.2	7	1.1	155	24.6	115	18.3	629	7.86	4.71	60.0
Do	479 clean fertile eggs in nests for layers (no sitters).	On arrival in town	60	13.2	210	46.1	10	2.2	0	0	0	0	142	31.2	34	7.5	456	5.70	3.30	58.0
		Before leaving town	33	7.2	195	42.8	11	2.4	0	0	0	0	165	36.2	52	11.4	456	5.70	3.74	65.6
		Arrival at packing house	31	6.8	164	36.2	5	1.1	1	.2	3	.7	127	28	123	27.1	454	5.67	4.01	70.8

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. The variation is due to eggs being broken or lost.

COMPARISON OF CLEAN INFERTILE EGGS UNDER SIX DIFFERENT CONDITIONS.

It may be noted from the data given in Table 11 concerning the clean infertile eggs in the various experiments: First, that eggs held in the cave gave the highest percentage of firsts at the farm and packing house, and that the eggs kept in the parlor of the dwelling house were second best. Second, instead of the greatest deterioration occurring in the eggs placed in the nests for layers, as was the case with fertile eggs, we find that those of the straw stack suffered the heaviest loss. Third, that the straw-stack condition was the most conducive to the production of spots and rots in infertile eggs. Fourth, excepting the cyclone cave, the final losses under all the other different conditions plainly show that they are not conducive to good quality in eggs. With the exception of the house experiment such results would naturally be expected.

TABLE 11.—*Comparison of clean infertile eggs under six different conditions.*

Time.	Total eggs and condition.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			No.	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*	*No.*	*P. ct.*		*Dollars.*	*Dollars.*	*Per ct.*
June 10 to Aug. 26.	385 clean infertile eggs in cave.	On arrival in town	375	97.4	4	1.0	6	1.6	0	0	0	0	0	0	0	0	385	4.81	0.05	1.0
		Before leaving town	369	95.9	10	2.6	6	1.6	0	0	0	0	0	0	0	0	385	4.81	.08	1.7
		Arrival at packing house	264	68.6	111	28.8	10	2.6	0	0	0	0	0	0	0	0	385	4.81	.60	12.5
Do.	350 clean infertile eggs in parlor of dwelling house.	On arrival in town	246	70.5	94	26.9	8	2.3	1	.3	0	0	0	0	0	0	349	4.36	.52	11.9
		Before leaving town	199	57.6	138	39.9	9	2.6	0	0	0	0	0	0	0	0	346	4.32	.74	17.1
		Arrival at packing house	164	47.4	171	49.4	9	2.6	0	0	1	.3	1	.3	0	0	346	4.32	.92	21.3
Do.	385 clean infertile eggs under corn-crib.	On arrival in town	266	70.2	108	28.5	5	1.3	0	0	0	0	0	0	0	0	379	4.74	.56	11.8
		Before leaving town	206	54.6	163	43.2	7	1.9	0	0	0	0	1	.3	0	0	377	4.71	.86	21.0
		Arrival at packing house	172	45.6	186	49.3	10	2.7	0	0	1	.3	6	1.6	2	.5	377	4.71	1.09	23.2
Do.	385 clean infertile eggs in weed nest.	On arrival in town	240	64.4	116	31.1	17	4.6	0	0	0	0	0	0	0	0	373	4.66	.66	14.2
		Before leaving town	200	53.9	154	41.5	17	4.6	0	0	0	0	0	0	0	0	371	4.64	.86	18.5
		Arrival at packing house	162	43.8	178	48.1	21	5.7	0	0	2	.5	7	1.9	0	0	370	4.62	1.10	23.8
Do.	385 clean infertile eggs in straw stack.	On arrival in town	108	29.1	226	60.9	10	2.7	0	0	23	6.2	0	0	4	1.1	371	4.64	1.52	32.8
		Before leaving town	86	23.6	230	63.1	12	3.3	0	0	32	8.8	0	0	4	1.1	364	4.55	1.66	36.5
		Arrival at packing house	90	24.8	230	63.4	16	4.4	0	0	8	2.2	0	0	19	5.2	363	4.54	1.57	34.6
Do.	385 clean infertile eggs in nests for layers (sitters present).	On arrival in town	192	50.8	164	43.4	12	3.2	0	0	0	0	8	2.1	2	.5	378	4.73	1.00	21.1
		Before leaving town	155	41.0	196	51.8	12	3.2	1	.3	0	0	11	2.9	3	.8	378	4.73	1.23	26.0
		Arrival at packing house	120	32.0	223	59.5	14	3.7	0	0	0	0	13	3.5	5	1.3	375	4.69	1.42	30.3

NOTE.—A comparison of the figures under column headed "Total eggs and condition" with those under column "Total eggs candled" will often show a variation. The variation is due to eggs being broken or lost.

A COMPARISON OF THE LOSSES IN CLEAN FERTILE AND INFERTILE EGGS UNDER ALL THE EXPERIMENTAL CONDITIONS.

From the data in Table 12 and the graphic representation in text figure 1 we note:

1. That in all three candlings the loss in fertile eggs is nearly twice that of the infertile. This point is of the utmost importance to the producer, since it demonstrates beyond a doubt that by removing the male birds as soon as the hatching season is over, which should be about the middle of May, the quality and value of the subsequent eggs, regardless of where they are kept, is increased very materially.

2. The increased loss in fertile eggs is due mainly to the development of blood rings and rots, which, as has been shown in the previous discussion, can easily occur even when the eggs receive good care on the farm. The fact that they are fertile makes them subject to rapid deterioration of such a nature as to render them unfit for consumption.

3. By referring to figure 1 it will be seen that practically two-thirds of the total loss in fertile and infertile eggs occurred on the farm, the remaining loss taking place in town and during transportation from town to packing house. It is highly probable that if the eggs had all been firsts when leaving the farm the above loss would have been materially lessened. The important point to be brought out, however, is that the haphazard methods followed in the production and care of eggs on the farm are the principal factors which must be eliminated if the quality of the commercial egg is to be improved. True, there is room for improvement in the methods of handling and transportation after the egg leaves the farm, but, as brought out in Table 1 (p. 22), the only depreciation occurring during transit in clean infertile eggs kept in the cyclone cave was a slight shrink in the contents of a part of them, thereby making it necessary to class them as seconds.

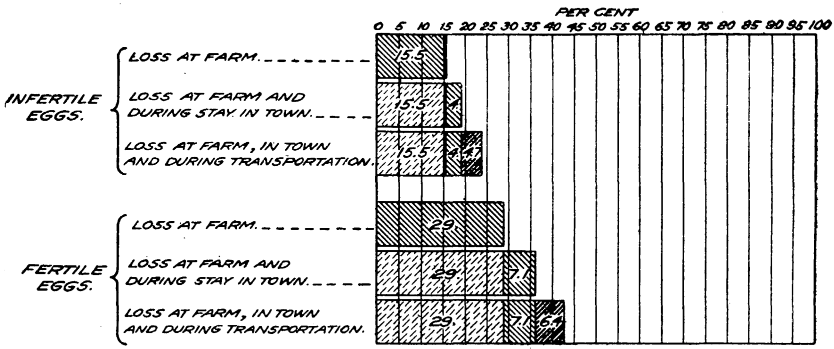

FIG. 1.—Showing per cent of loss in fertile and infertile eggs from farm to market. (See Table 12.)

TABLE 12.—*Condensed report showing loss in clean fertile and infertile eggs for entire season under all experimental conditions.*

Class of eggs.	Time.	When candled.	Results of candling.														Total eggs candled.	Original value of eggs, at 15 cents per dozen.	Loss.	
			Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.					
			Number.	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*	*Number.*	*Per cent.*		*Dollars.*	*Dollars.*	*Per cent.*
Fertile	June 10 to Aug. 26.	On arrival in town	916	40.6	1,106	49.0	39	1.7	0	0	14	0.6	167	7.4	15	0.7	2,257	28.21	8.17	29.0
Infertile	do	do	1,427	63.8	712	31.9	58	2.6	1	.0+	23	1.0	8	.4	6	.3	2,235	27.94	4.32	15.5
Fertile	do	Before leaving town	688	30.5	1,197	53.1	56	2.5	0	0	11	.5	273	12.1	29	1.3	2,254	28.17	10.17	36.1
Infertile	do	do	1,215	54.7	891	40.3	63	2.8	1	.0+	32	1.4	12	.5	7	.3	2,221	27.76	5.42	19.5
Fertile	do	On arrival at packing house.	614	27.3	1,063	47.4	64	2.9	1	.0+	22	1.0	298	13.3	183	8.2	2,245	28.06	11.93	42.5
Infertile	do	do	972	44.0	1,099	49.6	80	3.6	0	0	12	.5	27	1.2	26	1.2	2,216	27.70	6.71	24.2

RELATION OF TEMPERATURE TO DETERIORATION IN EGGS.

In the condensed reports of the different experiments it has only been possible to note the total depreciation for the season. Therefore it will be of interest to here note the deterioration in fertile and infertile eggs of various ages during moderately cool and extremely hot weather. Tables 13, 14, and 15 are detailed reports of 7-day experiments conducted in the parlor of the dwelling house, and the figures contained in them are the results of the first candling, which represents the loss at the farm. Figures 2 and 3 are thermograph reports of the temperature and humidity of the room during the time the above tests were made. The experiments started and ended on Saturday, as will be noted by referring to the thermograph records, where it will be seen that directly under Saturday there is a break in the line representing the temperature. This, of course, is occasioned by beginning and ending the record on the above day.

From figure 2, and the data in Table 13, which records the results of keeping fertile eggs in moderately cool weather, we note:

1. That the range of temperature for the seven days was between 63 and 88° F. 2. When subjected to the above range of temperature there was no loss in fertile eggs from one to six days old. 3. That in fertile eggs seven days old one out of six had deteriorated so as to become a second, which meant a decrease in quality of 16.7 per cent. The actual money loss, however, resulting from the above shrinkage in quality is but one-half a cent, which is not serious enough to be of significance. 4. That fresh fertile eggs placed in an unheated room of the dwelling house, the maximum daily temperature of which is 88° F., or under, will, if marketed frequently, be in sufficiently good condition to grade as firsts or full fresh eggs. There is a possibility that they would be in good condition at the expiration of seven days, but it is wiser to dispose of them at least twice a week.

Turning to Tables 14 and 15, where is given the depreciation during extremely hot weather, we find that after 24 hours 40 per cent of the fertile and 20 per cent of the infertile eggs had developed into seconds. At the age of four days 40 per cent of the fertile eggs are a total loss and on the fifth day 100 per cent. In the infertile eggs (Table 15) the rate of deterioration is not so great, but after the fourth day 100 per cent of the eggs are seconds. At the end of seven days the infertile eggs have a market value of 60 per cent of their original value, while the fertile eggs under the same conditions are a total loss.

The conclusions which may be drawn from the results of these three experiments are: First, that the quality of fertile and infertile eggs retained in a room of the dwelling house does not change to any appreciable extent during a period of from four to five days when the maximum temperature is 88° F., or under. Second, during extremely hot weather, when the daily maximum temperature is 100° F., or over, both fertile and infertile eggs start to deteriorate during the first 24 hours. The depreciation in fertiles is so rapid that after the fourth day they are a total loss, while in the infertiles, owing to the absence of fertilization, the loss is much less.

TABLE 13.—*Deterioration in fertile eggs kept in dwelling house during moderately cool weather.*

Number of eggs.	Age.	Results of candling.													
		Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.	
	Days.	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*
6.......	1	6	100.0	0	0	0	0	0	0	0	0	0	0	0	0
6.......	2	6	100.0	0	0	0	0	0	0	0	0	0	0	0	0
6.......	3	6	100.0	0	0	0	0	0	0	0	0	0	0	0	0
6.......	4	6	100.0	0	0	0	0	0	0	0	0	0	0	0	0
6.......	5	6	100.0	0	0	0	0	0	0	0	0	0	0	0	0
6.......	6	6	100.0	0	0	0	0	0	0	0	0	0	0	0	0
6.......	7	5	83.3	1	16.7	0	0	0	0	0	0	0	0	0	0
Total.42	......	41	97.6	1	2.4	0	0	0	0	0	0	0	0	0	0

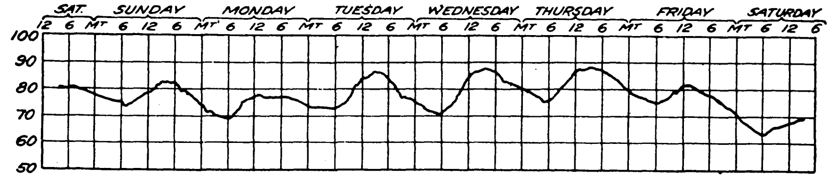

FIG. 2.—Thermograph record showing temperature in parlor of dwelling house during one week of moderately cool weather.

TABLE 14.—*Deterioration in fertile eggs kept in dwelling house during very hot weather.*

Number of eggs.	Age.	Results of candling.													
		Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.	
	Days.	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*
5.......	1	3	60.0	2	40.0	0	0	0	0	0	0	0	0	0	0
5.......	2	2	40.0	3	60.0	0	0	0	0	0	0	0	0	0	0
5.......	3	0	0	5	100.0	0	0	0	0	0	0	0	0	0	0
5.......	4	0	0	3	60.0	0	0	0	0	0	0	2	40.0	0	0
5.......	5	0	0	0	0	0	0	0	0	0	0	5	100.0	0	0
5.......	6	0	0	0	0	0	0	0	0	0	0	5	100.0	0	0
5.......	7	0	0	0	0	0	0	0	0	0	0	5	100.0	0	0
Total.35	......	5	14.3	13	37.2	0	0	0	0	0	0	17	48.5	0	0

TABLE 15.—*Deterioration in infertile eggs kept in dwelling house during very hot weather.*

Number of eggs.	Age.	Results of candling.													
		Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.	
	Days.	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*	*No.*	*P.ct.*
5	1	4	80.0	1	20.0	0	0	0	0	0	0	0	0	0	0
5	2	5	100.0	0	0	0	0	0	0	0	0	0	0	0	0
5	3	4	80.0	1	20.0	0	0	0	0	0	0	0	0	0	0
5	4	2	40.0	3	60.0	0	0	0	0	0	0	0	0	0	0
5	5	0	0	5	100.0	0	0	0	0	0	0	0	0	0	0
5	6	0	0	5	100.0	0	0	0	0	0	0	0	0	0	0
5	7	0	0	5	100.0	0	0	0	0	0	0	0	0	0	0
Total.35	......	15	42.9	20	57.2	0	0	0	0	0	0	0	0	0	0

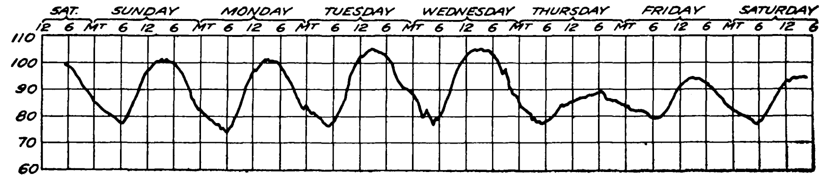

FIG. 3.—Thermograph record showing temperature in parlor of dwelling house for one week during hot weather.

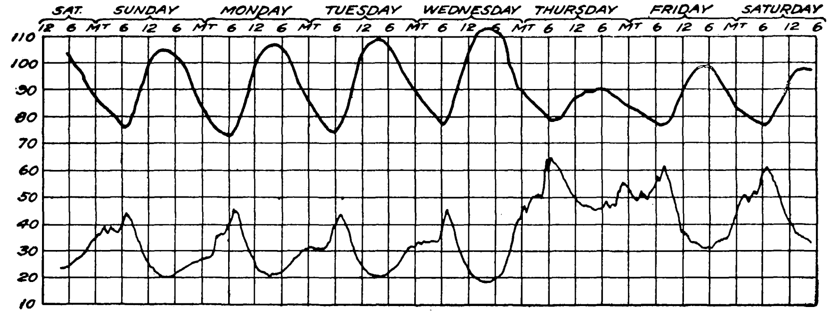

FIG. 4.—Temperature and humidity records for week of July 1 to 8, 1911. Upper line represents temperature; lower represents humidity. On Wednesday, July 5, it will be noticed, the temperature needle waa forced off the recording sheet, as it is designed to record temperature up to 110° F. only. The thermometer registered a temperature of 114° F. on this day.

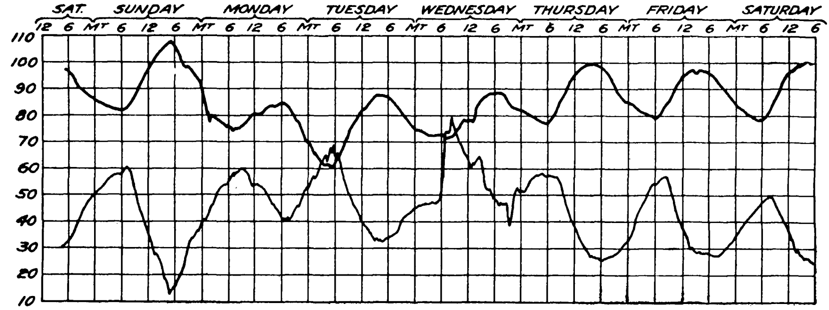

FIG. 5.—Temperature and humidity records taken from thermograph used in the house experiments for week June 24 to July 1, 1911. Upper line represents temperature; lower, humidity.

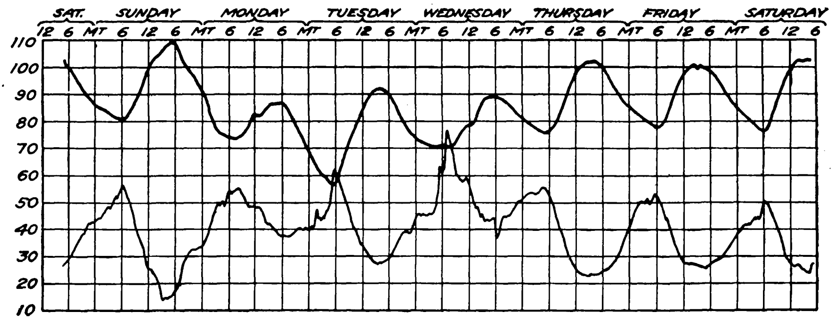

FIG. 6—Temperature and humidity records taken from thermograph used in outside experiments for week June 24 to July 1, 1911. Upper line represents temperature; lower, humidity.

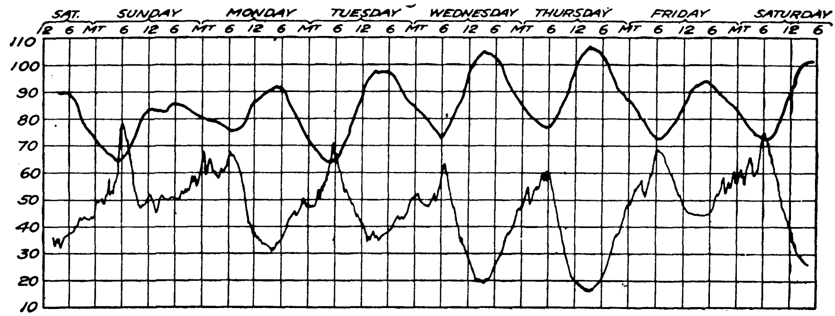

FIG. 7.—Temperature and humidity records from August 5 to 12, 1911. Upper line represents temperature; lower, humidity.

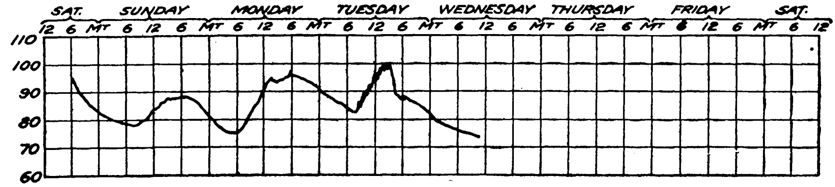

FIG. 8.—Thermograph record showing temperatures and length of time eggs were held in town, on train while standing, and in transit. The record begins at 6 p. m. Saturday, July 1, and ends at 10 a. m. Wednesday, July 5. The blotted line shows when the train was in motion, and the light smooth line that the eggs were held in the country store from 6 o'clock Saturday, July 1, until about 10 o'clock Monday, July 3, 1911. Eggs and thermograph were in open stock car. Note high temperature at 2 o clock Tuesday, July 4.

SUMMARY.

This paper constitutes a general study from a practical standpoint of the deterioration occurring in the various classes of fertile and infertile eggs when kept on the farm under different environmental conditions. The data on which this study is based are the results of extensive experimental egg work carried on in the State of Kansas. The chief results of these tests are summarized in the following paragraphs:

1. Eggs kept in the cyclone cave proved much better in quality than those kept under other conditions.

2. Taking the season as a whole, an unheated room in a dwelling house is not conducive to good quality in eggs.

3. During the hot summer months the conditions surrounding the weed nest, the nest in the straw stack, or under the corncrib, and the stolen nest, as well as the keeping of eggs in the house, favor the production of spots, blood rings, and rots.

4. The greatest deterioration in fertile eggs occurred in the experiments which included a certain amount of natural incubation, namely, in the nests for layers and the stolen-nest experiments.

5. The straw-stack experiment gave the greatest number of spots, both in fertile and infertile eggs, and also the highest percentage of rots in the latter class of eggs. It was the only test in which a large number of infertile eggs deteriorated to such an extent as to be unfit for food.

6. In fertile eggs the development of the embryo after 24 hours of incubation was of sufficient proportion to be recognized when held before the candle, and at the expiration of 36 hours the presence of blood was easily detected. In infertile eggs under the same conditions a slight shrinkage of the contents was the only change which could be recognized by the eye.

7. Infertile eggs, regardless of where they may be kept, are much more resistant to deterioration than fertile.

8. Two-thirds of the total loss in fertile and infertile eggs takes place on the farm. The basic factors responsible for this condition are the haphazard methods of poultry management on the farm.

9. If eggs are fresh when delivered to the buyer it is impossible, with the present methods of transportation, for them to reach the packing house without showing a slight deterioration in quality. The data at hand (see Table 1) would indicate that this loss is about 12 per cent of the original value of the eggs.

10. The results of all the experimental work point to the fact that the production of the infertile egg is the greatest asset in the attempt to produce high-quality market eggs during hot weather.

11. The authors believe that if the five simple rules given below are followed by egg producers generally a high quality of product will be assured and a very large part prevented of the loss now experienced in the value of the country's egg production:

Give the hens clean nests.

Gather eggs at least once daily.

Keep eggs in a cool, dry place.

Market eggs at least twice a week.

Kill or sell all mature male birds as soon as the hatching season closes.

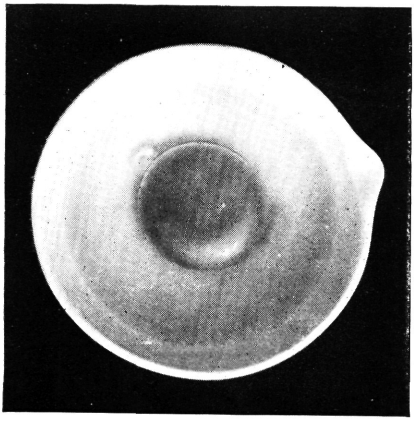

FIG. 1.—NORMAL FRESH EGG.

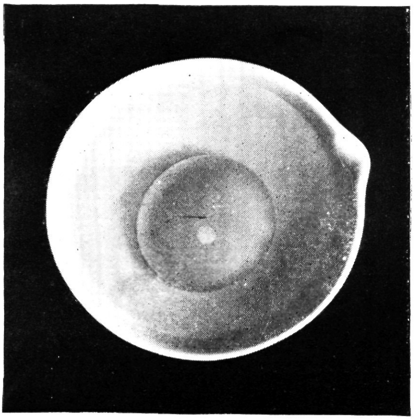

FIG. 2.—FRESH EGG SHOWING BLOOD CLOT.

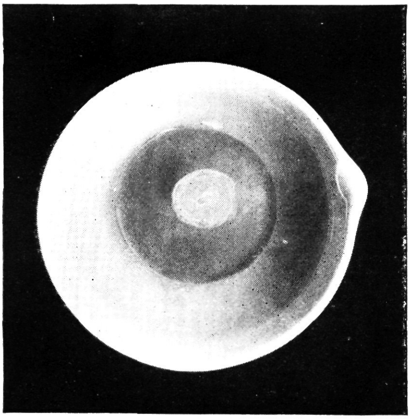

FIG. 3.—FERTILE EGG AFTER 24 HOURS OF INCUBATION.

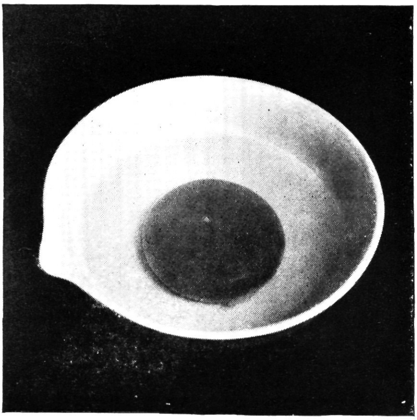

FIG. 4.—INFERTILE EGG AFTER 24 HOURS OF INCUBATION.

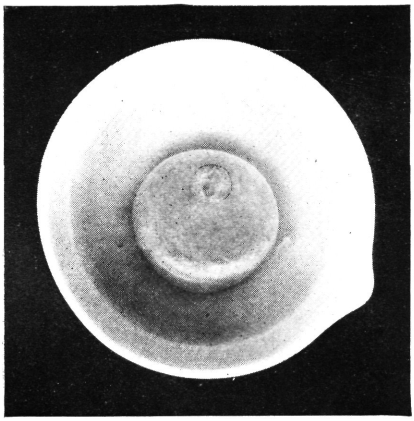

FIG. 1.—FERTILE EGG ALLOWED TO DIE AFTER 36 HOURS OF INCUBATION.

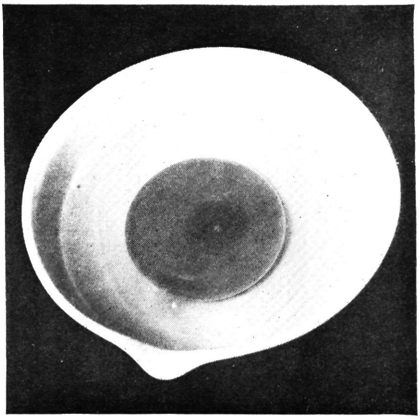

FIG. 2.—INFERTILE EGG AFTER 36 HOURS OF INCUBATION.

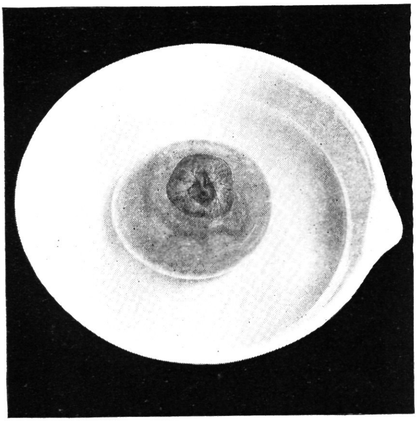

FIG. 3.—FERTILE EGG AFTER 48 HOURS OF INCUBATION.

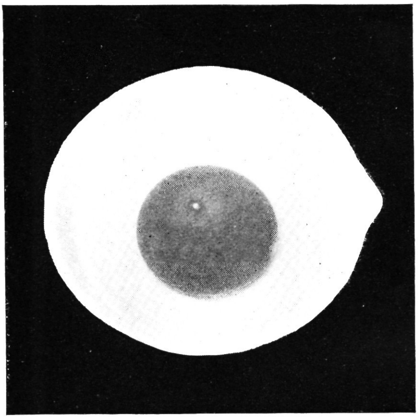

FIG. 4.—INFERTILE EGG AFTER 48 HOURS OF INCUBATION.

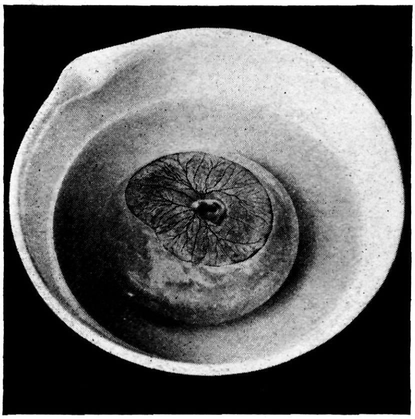

FIG. 1.—FERTILE EGG AFTER 72 HOURS OF INCUBATION.

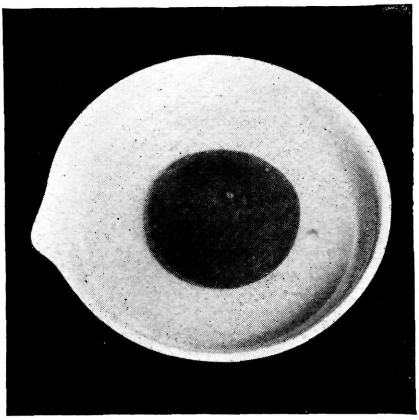

FIG. 2.—INFERTILE EGG AFTER 72 HOURS OF INCUBATION.

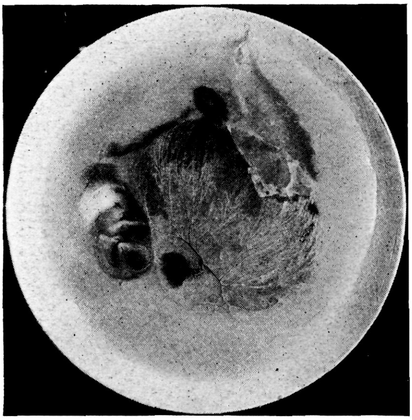

FIG. 3.—FERTILE EGG AFTER 7 DAYS OF INCUBATION.

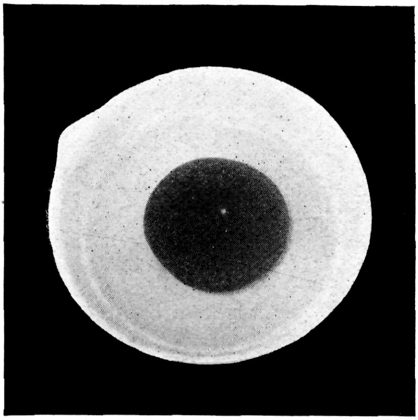

FIG. 4.—INFERTILE EGG AFTER 7 DAYS OF INCUBATION.

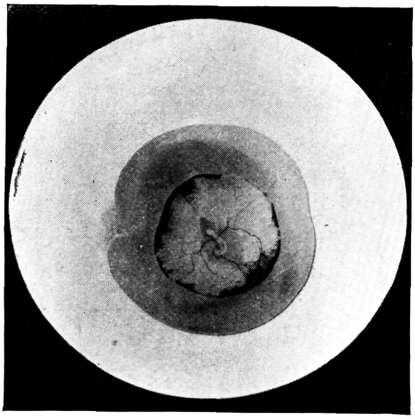

FIG. 1.—FERTILE EGG ALLOWED TO DIE AFTER 72 HOURS OF INCUBATION.

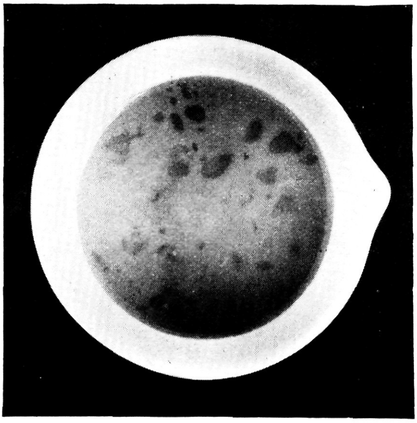

FIG. 2.—MIXED ROT.

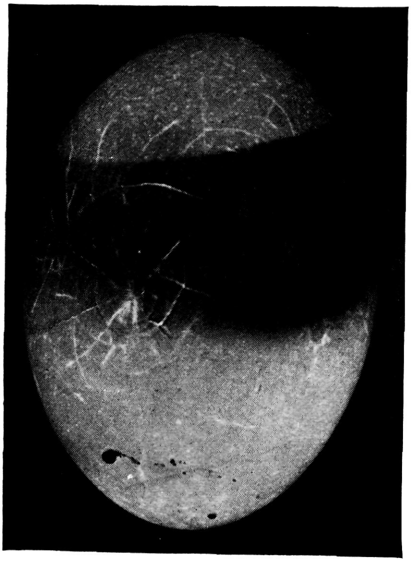

FIG. 3.—EGG SHOWING MOLD SPOT.

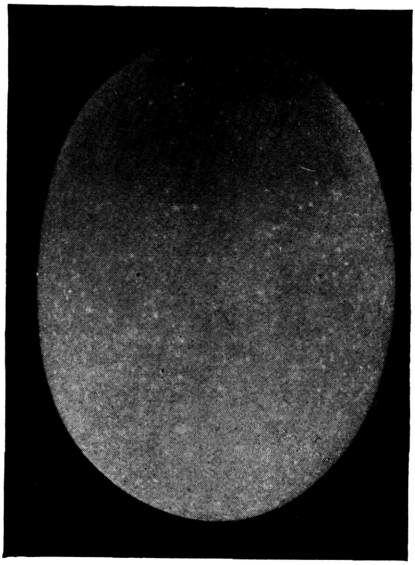

FIG. 4.—EGG SHOWING PLAIN SPOT.

APPENDIX.

As a sample of the way in which the complete data of the various experiments in this bulletin were placed on record, we append the details of the cyclone-cave experiment as carried out throughout the season, from April 24 to August 26, 1911. A condensed report of this experiment has previously been given as Table 2, on page 25. It is considered unnecessary to publish the complete records of the other experiments.

Detailed record of the

Experiment No.	Kind of eggs.	Number used per day.	Total eggs.[1]	Length of experiment.	Weather and temperature.[2]	When candled.
1	Fertile	6	36	Apr. 24-30	Tables 1, 2	On arrival in town Before leaving town Arrival at packing house
20	do	6	36	Apr. 30-May 6.	Tables 1, 2, 6	On arrival in town Before leaving town Arrival at packing house
21	Washed fertile	3	18	do	do	On arrival in town Before leaving town Arrival at packing house
22	Dirty fertile	3	18	do	do	On arrival in town Before leaving town Arrival at packing house
40	Fertile	6	42	May 6-13	Tables 2, 7; record 7.	On arrival in town Before leaving town Arrival at packing house
41	Dirty fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
42	Washed fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
57	Fertile	6	42	May 13-20	Tables 2, 8; record 10.	On arrival in town Before leaving town Arrival at packing house
58	Dirty fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
59	Washed fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
63	Fertile	6	30	May 22-27	Tables 2, 9; record 13.	On arrival in town Before leaving town Arrival at packing house
64	Dirty fertile	3	15	do	do	On arrival in town Before leaving town Arrival at packing house
65	Washed fertile	3	15	do	do	On arrival in town Before leaving town Arrival at packing house
87	Infertile	5	35	May 27-June 3.	Tables 2, 3, 10; record 16.	On arrival in town Before leaving town Arrival at packing house
88	Washed infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
89	Dirty infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
90	Fertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
91	Dirty fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
92	Washed fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
109	Infertile	5	35	June 3-10	Tables 3, 11; record 19.	On arrival in town Before leaving town Arrival at packing house
110	Dirty, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
111	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house

---

[1] A comparison of the figures under column headed "Total eggs" with those under column "Total eggs candled" will often show a variation. This variation is due to eggs becoming broken or lost.

[2] The tables and records referred to in this column are not those in the present bulletin. They are part of the original data on file in connection with the complete records of these experiments.

[3] Five eggs broken.

cyclone-cave experiment.

Results of candling.														Total eggs candled.[1]	Total deterioration (per cent).	Remarks.
Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.				
Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.			
36	100.0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	
36	100.0	0	0	0	0	0	0	0	0	0	0	0	0	36	0	
33	91.7	2	5.6	1	2.8	0	0	0	0	0	0	0	0	36	8.3	
31	100.0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	(3)
30	96.8	1	3.2	0	0	0	0	0	0	0	0	0	0	31	3.2	
25	80.6	5	16.1	1	3.2	0	0	0	0	0	0	0	0	31	19.4	
17	94.4	1	5.6	0	0	0	0	0	0	0	0	0	0	18	5.6	
16	88.9	2	11.1	0	0	0	0	0	0	0	0	0	0	18	11.1	
15	83.3	3	16.7	0	0	0	0	0	0	0	0	0	0	18	16.7	
16	94.1	1	5.9	0	0	0	0	0	0	0	0	0	0	17	5.9	(4)
16	94.1	1	5.9	0	0	0	0	0	0	0	0	0	0	17	5.9	
15	88.2	2	11.8	0	0	0	0	0	0	0	0	0	0	17	11.8	
41	100.0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	(4)
41	100.0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	
41	100.0	0	0	0	0	0	0	0	0	0	0	0	0	41	0	
19	95.0	1	5.0	0	0	0	0	0	0	0	0	0	0	20	5.0	(4)
19	95.0	1	5.0	0	0	0	0	0	0	0	0	0	0	20	5.0	
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
40	95.2	1	2.4	1	2.4	0	0	0	0	0	0	0	0	42	4.8	
34	81.0	7	16.6	1	2.4	0	0	0	0	0	0	0	0	42	19.0	
37	88.1	3	7.1	2	4.8	0	0	0	0	0	0	0	0	42	11.9	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
16	76.2	4	19.0	1	4.8	0	0	0	0	0	0	0	0	21	23.8	
17	81.0	4	19.0	0	0	0	0	0	0	0	0	0	0	21	19.0	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
18	90.0	1	5.0	1	5.0	0	0	0	0	0	0	0	0	20	10.0	(4)
30	100.0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	(5)
30	100.0	0	0	0	0	0	0	0	0	0	0	0	0	30	0	
29	96.7	0	0	1	3.3	0	0	0	0	0	0	0	0	30	3.3	
14	93.3	0	0	1	6.7	0	0	0	0	0	0	0	0	15	6.7	
14	93.3	0	0	1	6.7	0	0	0	0	0	0	0	0	15	6.7	
14	100.0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	(4)
14	93.3	0	0	1	6.7	0	0	0	0	0	0	0	0	15	6.7	
14	93.3	0	0	1	6.7	0	0	0	0	0	0	0	0	15	6.7	
12	80.0	2	13.3	1	6.7	0	0	0	0	0	0	0	0	15	20.0	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
32	91.4	2	5.7	1	2.9	0	0	0	0	0	0	0	0	35	8.6	
31	88.6	4	11.4	0	0	0	0	0	0	0	0	0	0	35	11.4	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	(4)
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
18	85.7	3	14.3	0	0	0	0	0	0	0	0	0	0	21	14.3	
18	85.7	3	14.3	0	0	0	0	0	0	0	0	0	0	21	14.3	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
32	91.4	2	5.7	1	2.9	0	0	0	0	0	0	0	0	35	8.6	
29	82.9	6	17.1	0	0	0	0	0	0	0	0	0	0	35	17.1	
18	94.7	0	0	1	5.3	0	0	0	0	0	0	0	0	19	5.3	(6)
18	94.7	0	0	1	5.3	0	0	0	0	0	0	0	0	19	5.3	
14	73.7	4	21.1	1	5.3	0	0	0	0	0	0	0	0	19	26.3	
18	85.7	1	4.8	2	9.5	0	0	0	0	0	0	0	0	21	14.3	
18	85.7	1	4.8	2	9.5	0	0	0	0	0	0	0	0	21	14.3	
16	76.2	5	23.8	0	0	0	0	0	0	0	0	0	0	21	23.8	
33	94.3	0	0	1	2.9	0	0	0	0	0	0	1	2.9	35	5.7	(7)
31	91.2	2	5.9	1	2.9	0	0	0	0	0	0	0	0	34	8.8	(4)
30	88.3	0	0	2	5.9	2	5.9	0	0	0	0	0	0	34	11.8	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	(4)
18	90.0	2	10.0	0	0	0	0	0	0	0	0	0	0	20	10.0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
16	84.2	3	15.8	0	0	0	0	0	0	0	0	0	0	19	15.8	(6)

[4] One egg broken.
[5] Five-day experiment.
[6] Two eggs broken.
[7] Rot due to carelessness of farmers.

Detailed record of the cyclone-

Experiment No.	Kind of eggs.	Number used per day.	Total eggs.	Length of experiment.	Weather and temperature.	When candled.
112	Fertile	5	35	June 3-10	Tables 3, 11; record 19.	On arrival in town Before leaving town Arrival at packing house
113	Dirty, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
114	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
131	Fertile	5	35	June 10-17	Tables 3, 12; record 22.	On arrival in town Before leaving town Arrival at packing house
132	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
142	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
143	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
157	Fertile	5	35	June 17-24	Tables 3, 13; record 25.	On arrival in town Before leaving town Arrival at packing house
158	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
159	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
160	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
180	Fertile	5	35	June 24-July 1.	Tables 3, 4, 14; record 28.	On arrival in town Before leaving town Arrival at packing house
181	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
182	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
183	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
203	Fertile	5	35	July 1-8	Tables 4, 15; record 31.	On arrival in town Before leaving town Arrival at packing house
204	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
205	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
206	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
223	Fertile	5	35	July 8-15	Tables 4, 16; record 34.	On arrival in town Before leaving town Arrival at packing house
224	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
225	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
226	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
243	Fertile	5	35	July 15-22	Tables 4, 17; record 37.	On arrival in town Before leaving town Arrival at packing house

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[1] One egg broken.

cave experiment—Continued.

Results of candling.														Total eggs candled.	Total deterioration (per cent).	Remarks.
Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.				
Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.			
33	94.3	1	2.9	1	2.9	0	0	0	0	0	0	0	0	35	5.7	
29	82.9	4	11.4	2	5.7	0	0	0	0	0	0	0	0	35	17.1	
28	82.4	4	11.8	2	5.9	0	0	0	0	0	0	0	0	34	17.6	(1)
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
19	90.5	0	0	2	9.5	0	0	0	0	0	0	0	0	21	9.5	
18	85.7	2	9.5	1	4.8	0	0	0	0	0	0	0	0	21	14.3	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
27	77.1	7	20.0	1	2.9	0	0	0	0	0	0	0	0	35	22.9	
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	(1)
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	
19	95.0	1	5.0	0	0	0	0	0	0	0	0	0	0	20	5.0	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
33	94.3	1	2.9	1	2.9	0	0	0	0	0	0	0	0	35	5.7	
32	91.4	2	5.7	1	2.9	0	0	0	0	0	0	0	0	35	8.6	
19	90.5	0	0	2	9.5	0	0	0	0	0	0	0	0	21	9.5	
19	90.5	0	0	2	9.5	0	0	0	0	0	0	0	0	21	9.5	
19	90.5	1	4.8	1	4.8	0	0	0	0	0	0	0	0	21	9.5	
33	94.3	1	2.9	1	2.9	0	0	0	0	0	0	0	0	35	5.7	
23	65.7	11	31.4	1	2.9	0	0	0	0	0	0	0	0	35	34.3	
3	8.6	32	91.4	0	0	0	0	0	0	0	0	0	0	35	91.4	
20	95.2	0	0	1	4.8	0	0	0	0	0	0	0	0	21	4.8	
10	47.6	10	47.6	1	4.8	0	0	0	0	0	0	0	0	21	52.4	
2	9.5	19	90.5	0	0	0	0	0	0	0	0	0	0	21	90.5	
32	91.4	2	5.7	1	2.9	0	0	0	0	0	0	0	0	35	8.6	
31	88.6	3	8.6	1	2.9	0	0	0	0	0	0	0	0	35	11.4	
4	11.4	31	88.6	0	0	0	0	0	0	0	0	0	0	35	88.6	
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	(1)
20	100.0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	
1	5.0	19	95.0	0	0	0	0	0	0	0	0	0	0	20	95.0	
34	97.1	1	2.9	0	0	0	0	0	0	0	0	0	0	35	2.9	
22	62.9	13	37.1	0	0	0	0	0	0	0	0	0	0	35	37.1	
0	0	31	88.6	0	0	0	0	2	5.7	2	5.7	0	0	35	100.0	
20	95.2	0	0	0	0	0	0	0	0	1	4.8	0	0	21	4.8	
14	66.7	6	28.6	0	0	0	0	0	0	1	4.8	0	0	21	33.3	
1	4.8	19	90.5	1	4.8	0	0	0	0	0	0	0	0	21	95.2	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
9	25.7	26	74.3	0	0	0	0	0	0	0	0	0	0	35	74.3	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
4	19.0	17	81.0	0	0	0	0	0	0	0	0	0	0	21	81.0	
32	91.4	1	2.9	2	5.7	0	0	0	0	0	0	0	0	35	8.6	
21	60.0	13	37.1	1	2.9	0	0	0	0	0	0	0	0	35	40.0	
1	2.9	28	80.0	4	11.4	0	0	0	0	1	2.9	1	2.9	35	97.1	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
14	66.7	6	28.6	1	4.8	0	0	0	0	0	0	0	0	21	33.3	
1	4.8	19	90.5	0	0	0	0	0	0	1	4.8	0	0	21	95.2	
32	91.4	1	2.9	2	5.7	0	0	0	0	0	0	0	0	35	8.6	
30	85.7	3	8.6	2	5.7	0	0	0	0	0	0	0	0	35	14.3	
13	37.1	20	57.1	2	5.7	0	0	0	0	0	0	0	0	35	62.9	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
20	95.2	0	0	1	4.8	0	0	0	0	0	0	0	0	21	4.8	
8	38.1	13	61.9	0	0	0	0	0	0	0	0	0	0	21	61.9	
29	82.9	4	11.4	2	5.7	0	0	0	0	0	0	0	0	35	17.1	
29	82.9	4	11.4	2	5.7	0	0	0	0	0	0	0	0	35	17.1	
20	58.8	10	29.4	4	11.8	0	0	0	0	0	0	0	0	34	41.2	(1)
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
12	57.1	8	38.1	1	4.8	0	0	0	0	0	0	0	0	21	42.9	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
27	77.1	6	17.1	2	5.7	0	0	0	0	0	0	0	0	35	22.9	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
32	94.1	1	2.9	1	2.9	0	0	0	0	0	0	0	0	34	5.9	(1)
32	94.1	1	2.9	1	2.9	0	0	0	0	0	0	0	0	34	5.9	
27	79.4	6	17.6	1	2.9	0	0	0	0	0	0	0	0	34	20.6	

Detailed record of the cyclone-

Experiment No.	Kind of eggs.	Number used per day.	Total eggs.	Length of experiment.	Weather and temperature.	When candled.
244	Washed, fertile	3	21	July 15-22	Tables 4, 17; record 37.	On arrival in town Before leaving town Arrival at packing house
245	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
246	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
263	Fertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
264	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
265	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
266	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
283	Fertile	5	35	July 29-Aug. 5.	Tables 4, 5, 19; record 43.	On arrival in town Before leaving town Arrival at packing house
284	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
285	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
286	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
303	Fertile	5	35	Aug. 5-12	Tables 5, 20; record 46.	On arrival in town Before leaving town Arrival at packing house
304	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
305	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
306	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
323	Fertile	5	35	Aug. 12-19	Tables 5, 21; record 49.	On arrival in town Before leaving town Arrival at packing house
324	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
325	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
326	Washed, infertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
343	Fertile	5	35	Aug. 19-26	Tables 5, 22; record 52.	On arrival in town Before leaving town Arrival at packing house
344	Washed, fertile	3	21	do	do	On arrival in town Before leaving town Arrival at packing house
345	Infertile	5	35	do	do	On arrival in town Before leaving town Arrival at packing house
346	Washed, infertile	3	21			On arrival in town Before leaving town Arrival at packing house

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[1] One egg broken.

cave experiment—Continued.

Results of candling.														Total eggs candled.	Total deterioration (per cent).	Remarks.
Firsts.		Seconds.		Cracked.		Leakers.		Spots.		Blood rings.		Rots.				
Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.			
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
19	90.5	2	9.5	0	0	0	0	0	0	0	0	0	0	21	9.5	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
33	94.3	1	2.9	1	2.9	0	0	0	0	0	0	0	0	35	5.7	
33	94.3	1	2.9	1	2.9	0	0	0	0	0	0	0	0	35	5.7	
29	82.9	3	8.6	3	8.6	0	0	0	0	0	0	0	0	35	17.1	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
15	71.4	5	23.8	0	0	0	0	1	4.8	0	0	0	0	21	28.6	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
31	88.6	4	11.4	0	0	0	0	0	0	0	0	0	0	35	11.4	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
18	85.7	3	14.3	0	0	0	0	0	0	0	0	0	0	21	14.3	
25	73.5	7	20.6	2	5.9	0	0	0	0	0	0	0	0	34	26.5	(1)
25	73.5	7	20.6	2	5.9	0	0	0	0	0	0	0	0	34	26.5	
19	55.9	12	35.3	3	8.8	0	0	0	0	0	0	0	0	34	44.1	
18	90.0	2	10.0	0	0	0	0	0	0	0	0	0	0	20	10.0	(1)
18	90.0	2	10.0	0	0	0	0	0	0	0	0	0	0	20	10.0	
13	65.0	6	30.0	1	5.0	0	0	0	0	0	0	0	0	20	35.0	
34	97.1	1	2.9	0	0	0	0	0	0	0	0	0	0	35	2.9	
34	97.1	1	2.9	0	0	0	0	0	0	0	0	0	0	35	2.9	
20	57.1	15	42.9	0	0	0	0	0	0	0	0	0	0	35	42.9	
18	85.7	3	14.3	0	0	0	0	0	0	0	0	0	0	21	14.3	
18	85.7	3	14.3	0	0	0	0	0	0	0	0	0	0	21	14.3	
12	57.1	9	42.9	0	0	0	0	0	0	0	0	0	0	21	42.9	
31	88.6	2	5.7	2	5.7	0	0	0	0	0	0	0	0	35	11.4	
30	85.7	3	8.6	2	5.7	0	0	0	0	0	0	0	0	35	14.3	
25	71.4	7	20.0	3	8.6	0	0	0	0	0	0	0	0	35	28.6	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
33	94.3	1	2.9	1	2.9	0	0	0	0	0	0	0	0	35	5.7	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	
26	74.3	9	25.7	0	0	0	0	0	0	0	0	0	0	35	25.7	
24	68.6	11	31.4	0	0	0	0	0	0	0	0	0	0	35	31.4	
18	51.4	17	48.6	0	0	0	0	0	0	0	0	0	0	35	48.6	
18	85.7	2	9.5	1	4.8	0	0	0	0	0	0	0	0	21	14.3	
17	81.0	3	14.3	1	4.8	0	0	0	0	0	0	0	0	21	19.0	
13	61.9	7	33.3	1	4.8	0	0	0	0	0	0	0	0	21	38.1	
34	97.1	0	0	1	2.9	0	0	0	0	0	0	0	0	35	2.9	
32	91.4	2	5.7	1	2.9	0	0	0	0	0	0	0	0	35	8.6	
26	74.3	6	17.1	3	8.6	0	0	0	0	0	0	0	0	35	25.7	
15	71.4	5	23.8	1	4.8	0	0	0	0	0	0	0	0	21	28.6	
14	66.7	6	28.6	1	4.8	0	0	0	0	0	0	0	0	21	33.3	
15	71.4	5	23.8	1	4.8	0	0	0	0	0	0	0	0	21	28.6	
33	94.3	2	5.7	0	0	0	0	0	0	0	0	0	0	35	5.7	
33	94.3	2	5.7	0	0	0	0	0	0	0	0	0	0	35	5.7	
29	85.3	4	11.8	1	2.9	0	0	0	0	0	0	0	0	34	14.3	(1)
17	85.0	3	15.0	0	0	0	0	0	0	0	0	0	0	20	15.0	(1)
17	85.0	3	15.0	0	0	0	0	0	0	0	0	0	0	20	15.0	
18	90.0	1	5.0	0	0	0	0	0	0	0	0	0	0	20	10.0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
35	100.0	0	0	0	0	0	0	0	0	0	0	0	0	35	0	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
20	95.2	1	4.8	0	0	0	0	0	0	0	0	0	0	21	4.8	
21	100.0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	